Fishery Data Series No. 97-7

# Assessment of Coho Salmon from the Kenai River, Alaska, 1995

by

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and

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February 1997

Alaska Department of Fish and Game

Division of Sport Fish

## Symbols and Abbreviations

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**Weights and measures (metric)**

| | |
|---|---|
| centimeter | cm |
| deciliter | dL |
| gram | g |
| hectare | ha |
| kilogram | kg |
| kilometer | km |
| liter | L |
| meter | m |
| metric ton | mt |
| milliliter | ml |
| millimeter | mm |

**Weights and measures (English)**

| | |
|---|---|
| cubic feet per second | $ft^3/s$ |
| foot | ft |
| gallon | gal |
| inch | in |
| mile | mi |
| ounce | oz |
| pound | lb |
| quart | qt |
| yard | yd |

Spell out acre and ton.

**Time and temperature**

| | |
|---|---|
| day | d |
| degrees Celsius | °C |
| degrees Fahrenheit | °F |
| hour (spell out for 24-hour clock) | h |
| minute | min |
| second | s |

Spell out year, month, and week.

**Physics and chemistry**

| | |
|---|---|
| all atomic symbols | |
| alternating current | AC |
| ampere | A |
| calorie | cal |
| direct current | DC |
| hertz | Hz |
| horsepower | hp |
| hydrogen ion activity | pH |
| parts per million | ppm |
| parts per thousand | ppt, ‰ |
| volts | V |
| watts | W |

**General**

| | |
|---|---|
| All commonly accepted abbreviations. | e.g., Mr., Mrs., a.m., p.m., etc. |
| All commonly accepted professional titles. | e.g., Dr., Ph.D., R.N., etc. |
| and | & |
| at | @ |
| Compass directions: | |
| east | E |
| north | N |
| south | S |
| west | W |
| Copyright | © |
| Corporate suffixes: | |
| Company | Co. |
| Corporation | Corp. |
| Incorporated | Inc. |
| Limited | Ltd. |
| et alii (and other people) | et al. |
| et cetera (and so forth) | etc. |
| exempli gratia (for example) | e.g., |
| id est (that is) | i.e., |
| latitude or longitude | lat. or long. |
| monetary symbols (U.S.) | $, ¢ |
| months (tables and figures): first three letters | Jan,...,Dec |
| number (before a number) | # (e.g., #10) |
| pounds (after a number) | # (e.g., 10#) |
| registered trademark | ® |
| trademark | ™ |
| United States (adjective) | U.S. |
| United States of America (noun) | USA |
| U.S. state and District of Columbia abbreviations | use two-letter abbreviations (e.g., AK, DC) |

**Mathematics, statistics, fisheries**

| | |
|---|---|
| alternate hypothesis | $H_A$ |
| base of natural logarithm | e |
| catch per unit effort | CPUE |
| coefficient of variation | CV |
| common test statistics | F, t, $\chi^2$, etc. |
| confidence interval | C.I. |
| correlation coefficient | R (multiple) |
| correlation coefficient | r (simple) |
| covariance | cov |
| degree (angular or temperature) | ° |
| degrees of freedom | df |
| divided by | ÷ or / (in equations) |
| equals | = |
| expected value | E |
| fork length | FL |
| greater than | > |
| greater than or equal to | ≥ |
| harvest per unit effort | HPUE |
| less than | < |
| less than or equal to | ≤ |
| logarithm (natural) | ln |
| logarithm (base 10) | log |
| logarithm (specify base) | $\log_2$, etc. |
| mideye-to-fork | MEF |
| minute (angular) | ' |
| multiplied by | x |
| not significant | NS |
| null hypothesis | $H_O$ |
| percent | % |
| probability | P |
| probability of a type I error (rejection of the null hypothesis when true) | α |
| probability of a type II error (acceptance of the null hypothesis when false) | β |
| second (angular) | " |
| standard deviation | SD |
| standard error | SE |
| standard length | SL |
| total length | TL |
| variance | Var |

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by

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February 1997

This investigation was partially financed by the Federal Aid in Sport Fish Restoration Act (16 U.S.C. 777-777K) under Project F-10-11, Job No. S-2-14.

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*This document should be cited as:*
*Carlon, Jamie A. and James J. Hasbrouck. 1997. Assessment of coho salmon from the Kenai River, Alaska, 1995. Alaska Department of Fish and Game, Fishery Data Series No. 97-7, Anchorage.*

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# ABSTRACT

The commercial harvest of wild coho salmon *Oncorhynchus kisutch* of Kenai River origin in selected Upper Cook Inlet fisheries was estimated in 1995 based on the recovery of harvested adults marked with coded wire tags and adipose finclips. The goal of the study was to estimate the harvest of these fish in the drift gillnet fishery and the eastside set gillnet fishery of the Central District of Upper Cook Inlet. An estimated 6,956 (SE = 347) coho salmon from the Kenai River were harvested in the drift gillnet fishery and 13,165 (SE = 586) were harvested by the eastside set gillnet fishery. These commercial harvest estimates are the third available for coho salmon from the Kenai River. The harvests represented 3% of the total drift gillnet harvest of 234,126 coho salmon and 29% of the total eastside set gillnet harvest of 44,750 coho salmon.

Harvest estimates in 1995 were similar to those estimated in 1993 and 1994. Geographic and temporal trends in harvest were also similar. Most (97%) coho salmon from the Kenai River were harvested during the last week of July through the second week of August. Geographic trends in the drift gillnet fishery could not be discerned because harvests delivered to processing locations were usually a mix of fish from multiple statistical areas. In the eastside set gillnet fishery, there was a general decreasing trend in the portion of the total harvest comprised of coho salmon from the Kenai River from the southernmost statistical area to the northernmost.

Coded wire tags recovered from the drift gillnet fishery were also examined to determine the effect of fishery restrictions on the harvest of coho salmon from the Kenai River. The harvest of coho salmon of Kenai River origin during restricted fishing periods did not increase even though the restriction concentrated fishing effort closer to the mouth of the Kenai River.

About 170,000 coho salmon smolt were marked in 1994 at the Moose River, a tributary to the Kenai River. The marked portion of the 1995 adult inriver return, as measured from sport harvest samples, ranged from 0.18 to 0.32 among weekly periods during the sport fishery (August 1 through September 20, 1996). Although it is not known if the sport harvest was sampled in proportion to harvest over time, smolt emigrating from the Moose River mixed with unmarked fish from across the Kenai River drainage prior to sampling the adult return in 1995 to such an extent that a relatively unbiased estimate of the portion marked (0.27) was obtained for the purpose of estimating commercial harvest.

Based on the number of smolt marked, the number of sport harvested adults examined for marks, and the number of marked adults observed, an estimated 628,909 (SE = 14,788) coho salmon smolt emigrated from the Kenai River in 1994. Precise placement of coded wire tags through proper selection of tag injector headmolds likely resulted in the low tag loss rate of 3% during the experiment.



Key words: coho salmon, *Oncorhynchus kisutch,* sustained yield, contribution, commercial harvest, coded wire tag, Kenai River, smolt abundance, tag loss.


# INTRODUCTION

## BACKGROUND

Coho salmon *Oncorhynchus kisutch* spawn and rear in freshwater drainages of Upper Cook Inlet (UCI, Figure 1). Adults returning to spawn are harvested annually in mixed-stock commercial and sport marine fisheries. Sport and personal use harvests also occur in fresh water. The largest sport harvests and the fifth largest commercial harvests of coho salmon in the state of Alaska occur in UCI (Figure 2).

In 1991, the Alaska Department of Fish and Game (ADF&G) initiated a program to assess the status of UCI coho salmon stocks. Despite the importance of UCI coho salmon fisheries, no such program existed before 1991. A primary study component of the program involves the wild population of coho salmon from the Kenai River. This population was selected for assessment because of concerns regarding a history of large, annual inriver harvests, an increasing trend in angler effort, and an unknown level of exploitation. These coho salmon support the largest

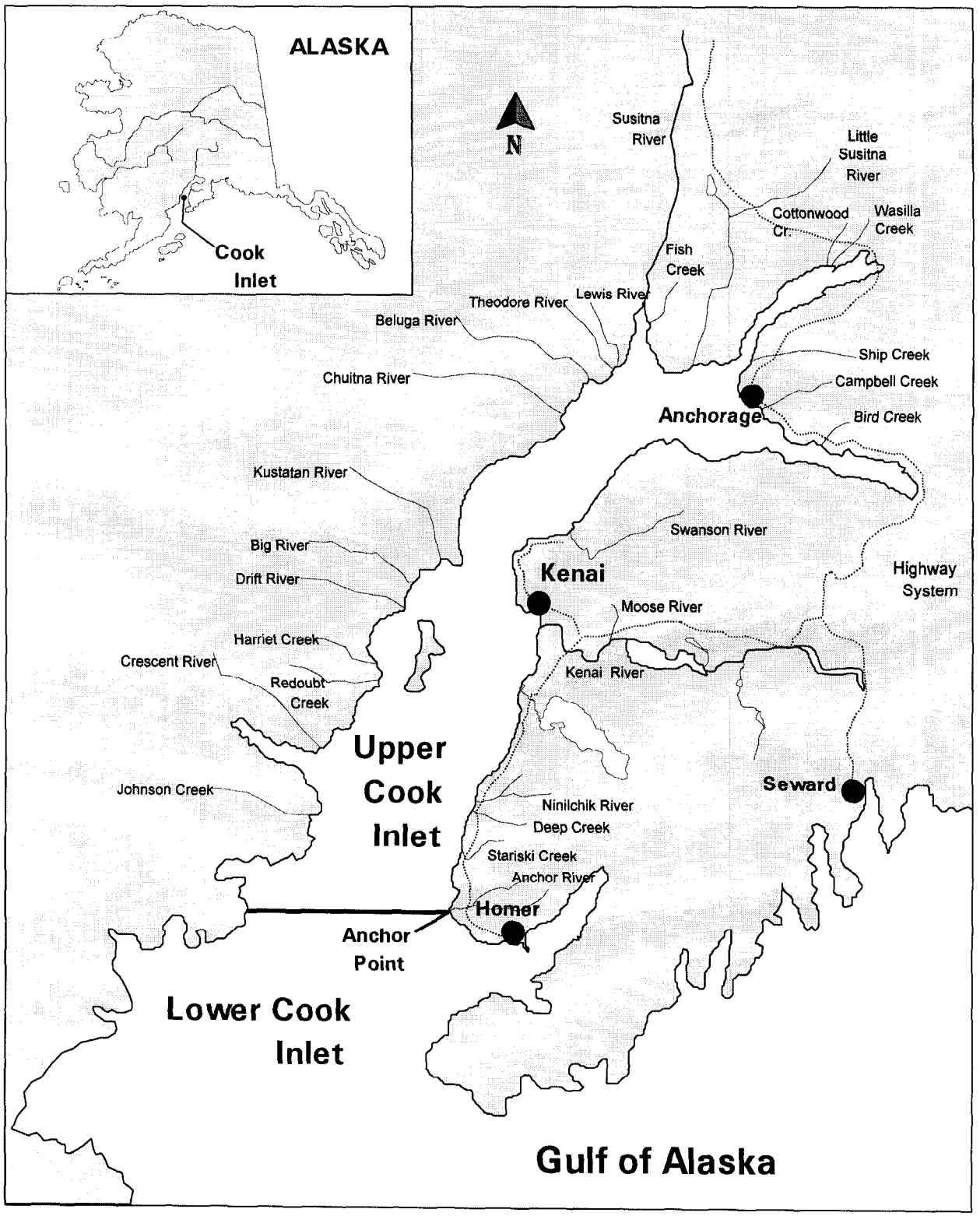
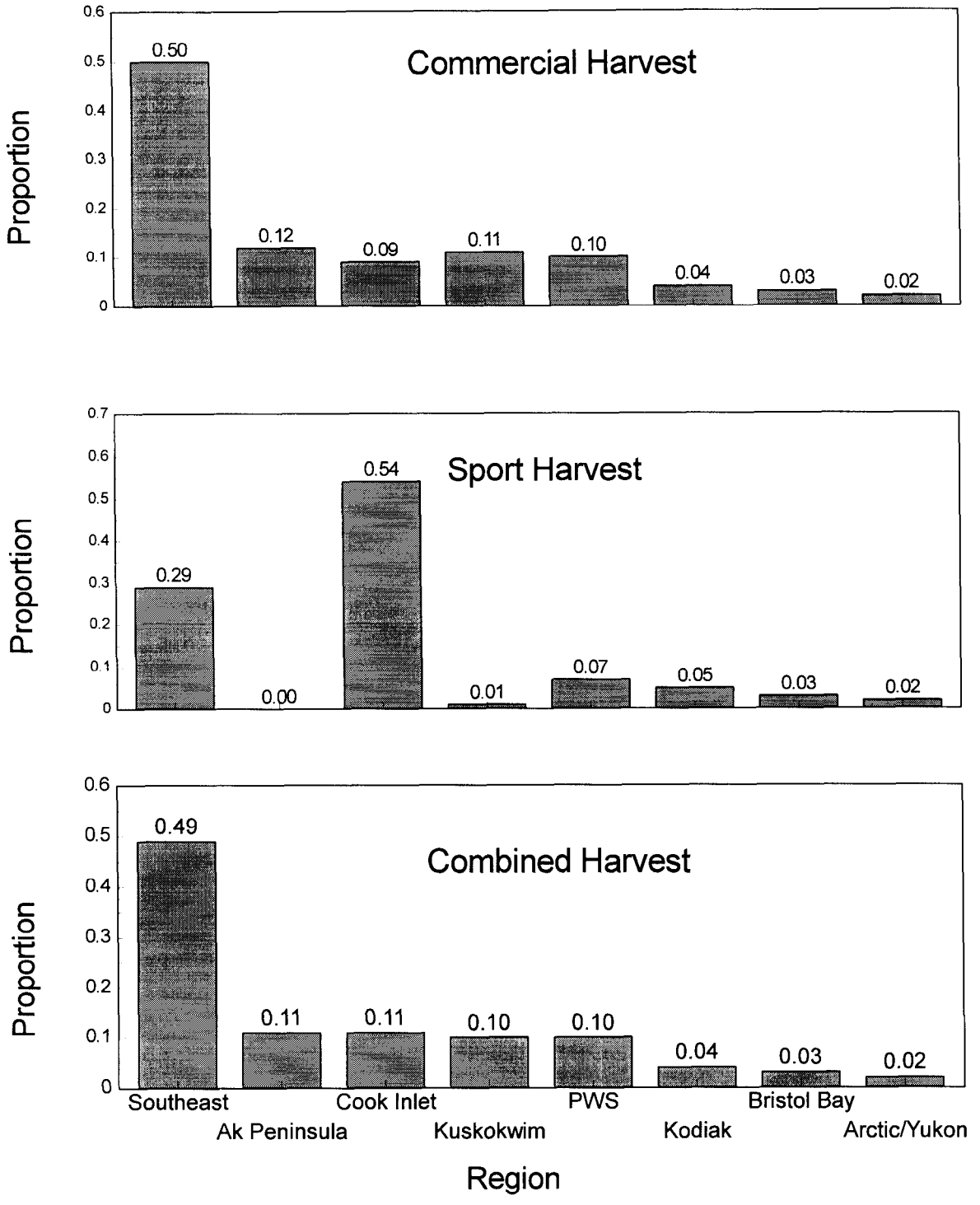



**Figure 1.-Map of the Cook Inlet Basin with selected tributaries known to support coho salmon.**




Data from: Rigby et al. (1991); Howe et al. (1995); ADF&G Fish Ticket Database

**Figure 2.-Average proportions of the statewide commercial and sport harvests of coho salmon by region, 1985-1994.**

freshwater sport harvest in the state (Mills 1979-1994; Howe et al. 1995) and contribute to the commercial marine harvests of UCI. Marine sport and inriver personal use fisheries also occur along migratory approach routes to Kenai River spawning areas.

The initial goal of the Kenai River stock assessment program was to estimate annual exploitation and production rates to determine if exploitation is threatening sustained production. The approach was to annually estimate: (1) the inriver sport and personal use harvests, (2) the spawning escapement, and (3) the stock-specific harvest in marine commercial fisheries. Annual harvests in the marine sport fishery are currently small relative to the total harvest and are considered insignificant at this time. Although the inriver sport and personal use harvests are estimated annually by angler surveys (Hammarstrom 1977, 1978 and 1988-1992; Schwager-King 1993; Mills 1979-1994; Howe et al. 1995), spawning escapements have never been estimated and commercial harvests were not estimated prior to 1993. Total adult production therefore remains unknown.

Smolt production estimates have become available beginning in 1993 as ancillary information to estimates of commercial harvest. Smolt production is therefore being considered as an alternative to adult production for assessing stock status. Monitoring of smolt production may obviate costly and complex procedures to estimate adult returns. However, consideration of adult studies has not been abandoned. Monitoring smolt is considered a long-term approach which may not provide for a timely conservation response; the Kenai River population will continue to contribute to commercial harvests and there has been an increasing trend in the inriver sport harvest since 1977 to a record high of 87,000 fish in 1994 (Mills 1979-1994, Howe et al. 1995).

This report documents study procedures and estimates of the commercial harvest (in 1995) and smolt abundance (in 1994) of coho salmon from the Kenai River. Estimates of the 1995 inriver recreational and personal use harvests will become available late in 1996. These estimates, when combined with the commercial harvest estimates presented in this report, will represent the third consecutive annual estimate of total harvest for this population. Because the first estimate of parent year harvest was made in 1993 (Carlon and Hasbrouck 1994), the first paired estimates of parent year harvest and subsequent smolt production will become available when the 1997 smolt production is estimated. Due to expected variability in the harvest-smolt relationship, the number of annual paired estimates needed to identify a sustainable yield with this method is not known. This illustrates the long-term nature of this endeavor.

## STUDY AREA

Smolt were captured for marking in 1994 as they emigrated from the Moose River (Figure 3), a tributary to the Kenai River at Kenai River kilometer (rkm) 60.5. Samples of adults sport harvested from the lower 34 km of the Kenai River were examined in 1995 to estimate the portion of the return bearing tags. Samples of adults commercially harvested in the drift and eastside set gillnet fisheries of the Central District and the set gillnet fisheries of the Northern District were examined in 1995. The statistical area of examined harvests was recorded when possible (Figure 4).

### OBJECTIVES

The primary objective of this study was to estimate the harvest of coho salmon of Kenai River origin in the eastside set gillnet and drift gillnet fisheries of the Central District of UCI in 1995.

Prerequisite objectives were to:

1. test the null hypothesis that the marked proportion remained constant over the duration of the return in August and September; and, if constant,
2. estimate the marked proportion of the adult population returning to the Kenai River from August 1 through September 30, 1995.

## METHODS

### EXPERIMENTAL DESIGN AND ASSUMPTIONS

Harvest of a population of salmon in a mixed-population fishery can be estimated by marking juveniles in fresh water at a similar lifestage and recovering marked adults in the fishery. Total harvest in the fishery and the fraction of fish in the population of interest bearing marks must be known or estimated. The number of marks recovered from the fishery can then be expanded into a population-specific harvest estimate to account for unmarked fish in the population and for the portion of the total harvest not examined.

To estimate commercial harvest of coho salmon from the Kenai River, a sample of juvenile coho salmon was captured from within the Kenai River drainage in 1994, marked with coded wire tags, and released. Total harvest of coho salmon in 1995 commercial fisheries was available from the Alaska Department of Fish and Game commercial fishery fish ticket database system. The fraction of the adult return bearing marks was estimated by examining the inriver sport harvest in 1995.

An assumption of this methodology is that marked individuals are a representative sample of the drainage-wide smolt emigration or of the subsequent adult return with respect to return timing (Clark and Bernard 1987). Marked individuals must mix with unmarked individuals in the population such that the fraction of marked individuals remains constant throughout the adult return. This assumption was evaluated by examining coho salmon harvested in the Kenai River sport fishery for marks and testing the hypothesis that the marked fraction did not change over time. Failure to reject this hypothesis would indicate that marked individuals mixed with unmarked individuals between the marking and recovery events so that the marked fraction could be estimated by pooling samples from the sport fishery over time. Mixing would also imply that the inriver marked fraction equaled the marked fraction of the population as it passed through commercial harvest areas prior to entering the river. The marked fraction passing through commercial fishery areas must be known or estimated to achieve the objective of estimating commercial harvest. Rejecting the hypothesis would indicate that marked individuals were a biased sample of the population and estimating the commercial harvest of the population may not be possible unless bias is minimal.

### JUVENILE MARKING

Juveniles were captured for marking in 1994 at a single location within the Kenai River drainage. Prior to 1994, juveniles were captured at a variety of locations (Carlon 1992; Carlon and

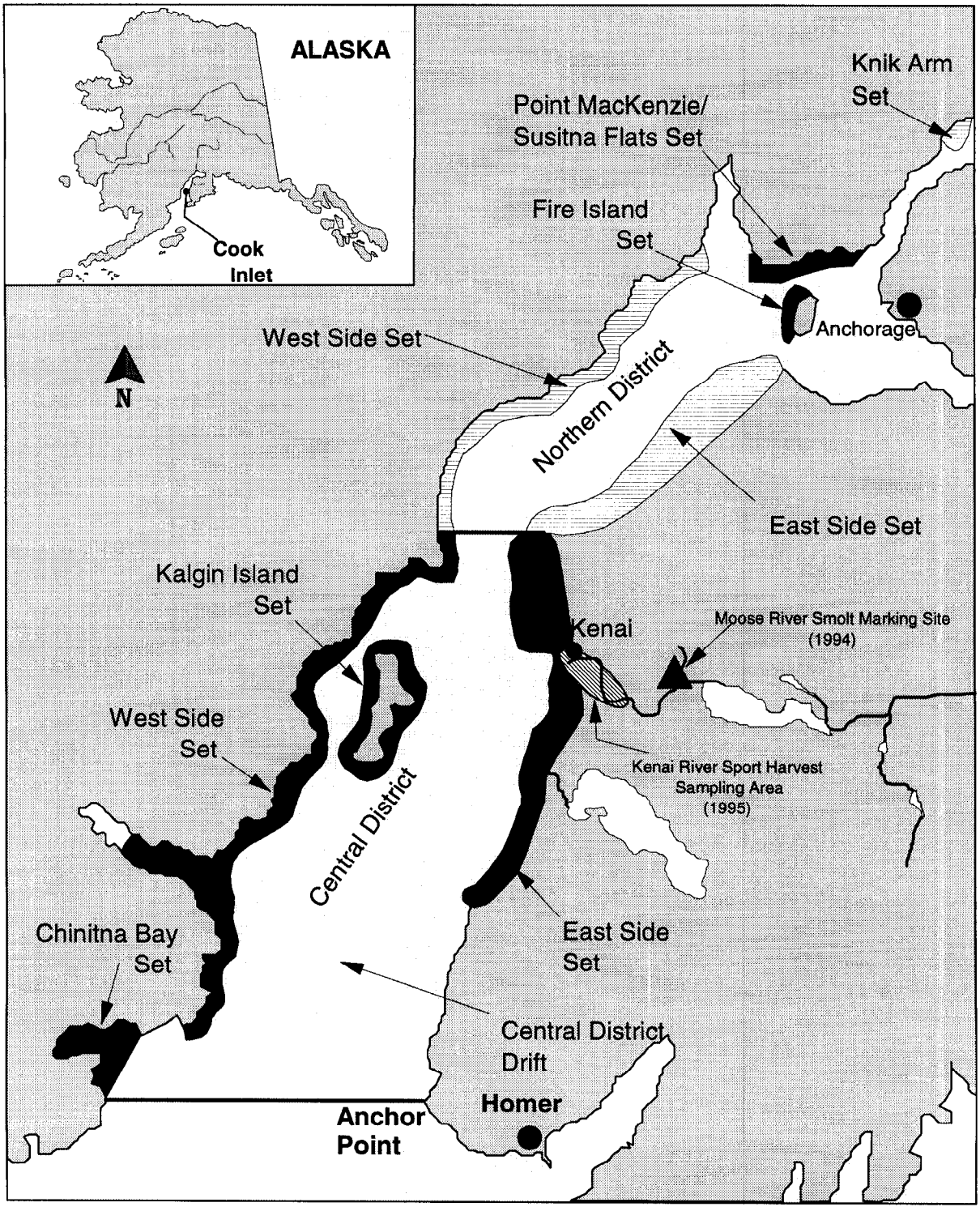



**Figure 3.-Schematic map of Upper Cook Inlet showing nine commercial set gillnet and drift gillnet fishery areas, location at which marked coho salmon smolt were released in the Kenai River drainage in 1994, and Kenai River section in which the sport harvest was examined in 1995.**

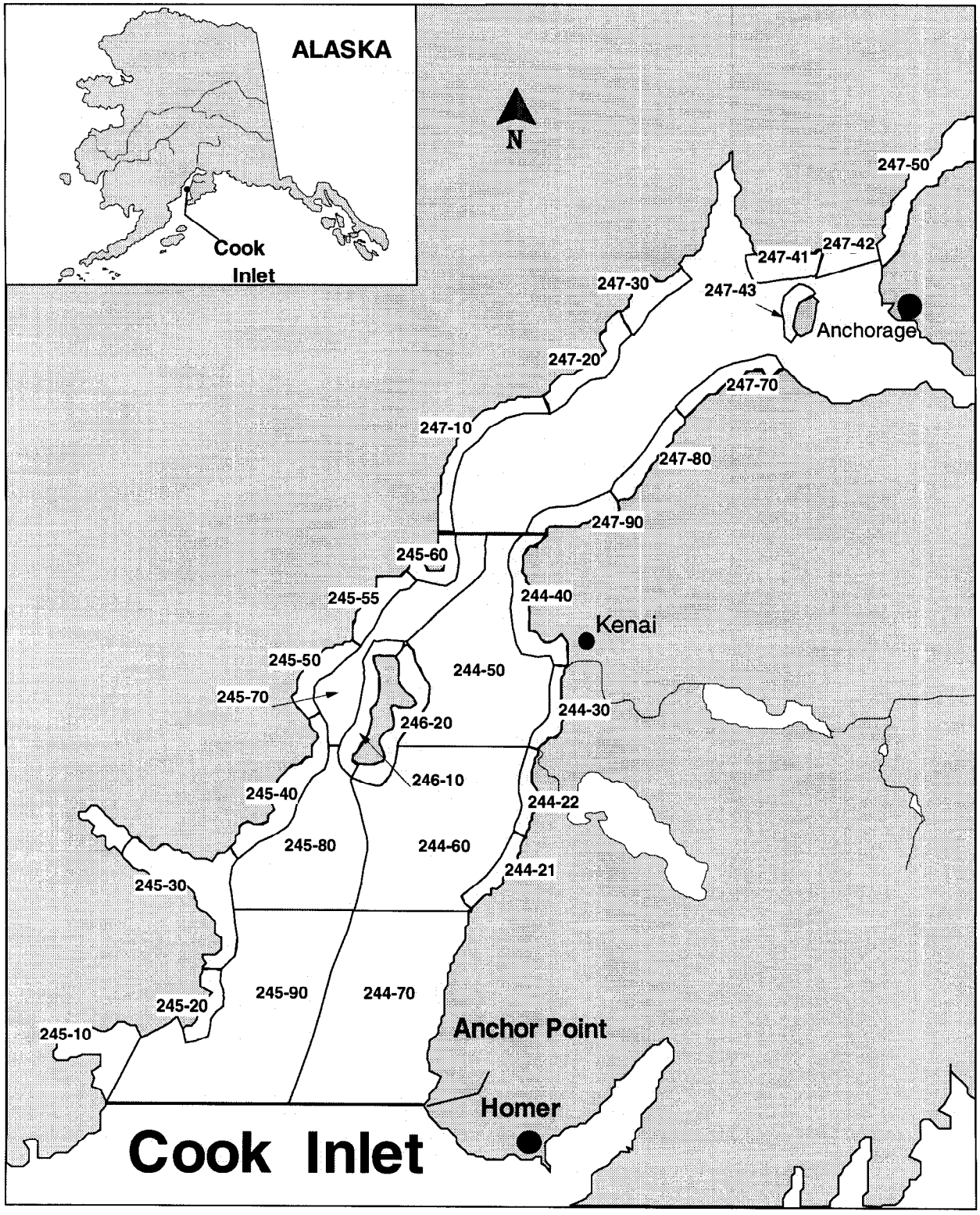



**Figure 4.-Schematic map of Upper Cook Inlet statistical areas.**

Hasbrouck 1993). However, subsequent recoveries of adults marked as juveniles indicated that the Moose River was the only location that provided a suitable sample of smolt for marking (Carlon and Hasbrouck 1994). In addition to providing access to a sufficient number, the Moose River provided smolt that fulfilled the experimental design requirement that the marked sample be representative of the entire Kenai River population with respect to the adult return timing trait (Carlon and Hasbrouck 1994). Therefore, in 1994, juveniles were marked only at the Moose River.

Tagging of coho salmon juveniles during the spring emigration from the Moose River in previous years (1992 and 1993) indicated that smolt were present in the emigration. Tags recovered from marked adults returning to spawn in 1993 and 1994 had been implanted in juveniles emigrating from the Moose River the prior year (Carlon and Hasbrouck 1994; Carlon and Hasbrouck 1996). Tags implanted during all segments of the 1992 and 1993 emigrations have been recovered from adults. In addition, the similar behavior (mass downstream migration), appearance (silver skin pigment obscuring parr marks), migration timing (about May 20 through June 15), and narrow length distributions (Carlon 1992; Carlon and Hasbrouck 1993) are indications that most of the juvenile coho salmon emigrating from the Moose River each spring are smolt. Although juveniles shorter than 100 mm (fork length) were present during each emigration, these were not marked because they were substantially different in appearance (parr marks visible and less silver pigment), there were relatively few of them, and scale samples from fish shorter than 100 mm all exhibited only one annulus. Most coho salmon smolt from the Kenai River after 2 years in fresh water (Hammarstrom 1988-1992).

A weir was installed in the mainstem of the Moose River at rkm 7.5 to capture smolt as they emigrated from overwintering lakes in the drainage. The weir was a total barrier to fish migration during the period May 20 through June 19, 1994. Fish captured in a weir trap throughout each day were partially immobilized by sedating with MS-222 to a level-two anesthesia as defined by Yoshikawa et al. (1988), hand-sorted into one of three length groups, and transferred to instream holding pens. In prior years, fish in excess of holding pen capacity (about 6,000 fish) were passed directly through the trap to continue their downstream migration. Fish that could not be marked within 48 hours of being placed in holding pens were released untagged. In 1994 however, virtually all smolt arriving at the weir were marked and released. Subjective observations of smolt holding upstream of the weir indicated that migration timing was more protracted than in prior years and most fish arriving at the weir each day were marked within 1 day of arrival. This permitted the marking of all smolt captured during 1994 with the exception of several hundred fish that either escaped or died during capture or handling.

Fish were handled and marked following standard coded wire tagging procedures (Moberly et al. 1977). Buckets were used to transfer smolt from holding pens to a marking facility located on the stream bank near the weir trap. Fish were sedated to a level-three anesthesia as described by Yoshikawa et al. (1988) and the adipose fin was excised with surgical scissors. All were then tagged with a Northwest Marine Technologies® Mark IV tag injector fitted with the optimal headmold for each length group. Fish $\leq$ 125 mm were tagged using a 30-per-pound headmold, those $>$ 125 mm and $\leq$ 150 mm were tagged with a 20-per-pound headmold, and those $>$ 150 mm were tagged with a 15-per-pound headmold. Headmolds were chosen to result in proper and

precise tag placement in fish of each length group (Northwest Marine Technologies, Inc. 1990; Peltz and Hansen 1994). All marked fish were released to continue their downstream migration.

Groups of smolt were batch marked; a single tag code was applied to all individuals in the group. The number marked per group ranged from 4,352 to 12,175 depending on the number of tags per tag spool. This resulted in 19 tag code groups being released during the emigration.

Short-term survival and tag retention rates were estimated for juveniles marked during each tagging shift by detaining samples of about 200 marked fish in holding pens overnight. Substantial tag loss or mortality as measured in overnight samples would indicate the need for quality control measures in the handling or marking of fish. Survival and tag retention rates were also used to estimate the total number of smolt that survived tagging and retained tags after release. This estimate was required to estimate the 1994 smolt abundance.

## HARVEST SAMPLING AND MARK RECOVERY

Sport and commercial harvests were examined to recover marked coho salmon. The sport harvest was examined to estimate the proportion bearing marks; the commercial harvest was examined to recover marked fish of known origin.

### Sport Fishery

Sport fishing for coho salmon occurs throughout the Kenai River mainstem from its mouth upstream to the outlet of Kenai Lake. The majority of the harvest occurs in the lower 34 km of the river downstream from the Sterling Highway bridge in the town of Soldotna. The fishery occurs primarily during August and September, after which harvest and effort decline to low levels. Only limited spawning occurs in tributaries to this section of the mainstem.

During August and September 1995, coho salmon sport harvested from the lower 34 km of the Kenai River were examined for a missing adipose fin. Daily counts of fish examined and of those missing an adipose fin were recorded. Heads were collected from most adipose-clipped fish and shipped to the ADF&G Tag Lab in Juneau. Some anglers desired trophy mounts or entered fish in salmon derby contests; heads were not recovered in these cases. Examined fish were marked by punching a hole in the caudal fin to avoid examining fish twice.

Examining fish harvested in the lower 34 km of the mainstem Kenai River provided the best opportunity to examine a random sample of the adult return for the purpose of estimating the marked fraction in 1995. Because a creel survey was not executed in 1995, it is not known if the sport harvest samples were temporally proportional to the sport harvest. Therefore, to estimate the marked fraction of the return, it must be assumed that the sport harvest from this river section represented a random sample of the return. This is likely a valid assumption because of the wide distribution of angler effort (both spatially and temporally) and because estimates of catch and harvest are nearly identical (Hammarstrom 1992; Schwager-King 1993) indicating that the sport fishery is nonselective. The validity of this assumption, however, has not been directly tested in this study.

### Commercial Fishery

Central District commercial fisheries harvest coho salmon between late June and early September. After mid-August, the eastside set gillnet fishery was closed by regulation and the drift gillnet fishery was restricted to the western side of Cook Inlet. Drift gillnetting occurs on

the western side of the inlet until numbers of fish decline to low levels, typically in early September. In 1995, the drift gillnet season opened by regulation on June 26 and the eastside set gillnet season opened on July 3. The fisheries are managed primarily for sockeye salmon *O. nerka* through various combinations of time and area restrictions. Fishery management guidelines are described in the Upper Cook Inlet Salmon Management Plan; 1995 management actions are documented by Ruesch and Fox (*In prep*).

Commercially harvested coho salmon were examined at processing plants, buying stations, and aboard tenders throughout UCI to determine the fraction of the harvest consisting of marked fish and to recover coded wire tags from marked fish. Fisheries selected for sampling during 1995 included the drift gillnet and the eastside set gillnet fisheries of the Central District and the set gillnet fisheries of the Northern District. These areas historically account for most of the UCI harvest (Ruesch and Fox 1995). Northern District fisheries typically harvest less than a few hundred coho salmon of Kenai River origin (Carlon and Hasbrouck 1994), but were sampled to estimate the contribution of hatchery-produced coho salmon stocked in Northern District streams (Cyr et al. *In prep*). The Central District eastside set gillnet harvest was examined until the fishery closed on August 14. The drift gillnet and the Northern District harvests were examined until harvests declined to low levels in early September. Harvests in other fisheries were sampled incidentally throughout the season.

Sampling personnel roved among commercial processing locations (main plants and buying stations) and recorded daily totals of the number of coho salmon examined and the number that were missing an adipose fin. Heads were collected from adipose-clipped fish, frozen, and later shipped to the Tag Lab for retrieval of the embedded coded wire tag. The following information was also recorded: date sold (date harvested), statistical area of harvest when available, and processor. In general, the statistical area was known for set gillnet harvests. Drift gillnet harvests were typically an unknown mixture of fish from multiple statistical areas.

## DATA ANALYSIS

Several data analysis steps were required to achieve the annual study goals of estimating smolt production and total harvest of coho salmon from the Kenai River. These are: (1) estimating the number of smolt marked in 1994 that survived marking and retained a coded wire tag, (2) estimating the marked proportion of the adult return in 1995, and (3) generating the harvest estimates for the two commercial fisheries of interest in 1995.

### Smolt Marking at the Moose River in 1994

The number of smolt marked and released during each of two marking shifts per day was adjusted to account for short-term mortality and tag loss. An estimate of the number of smolt released that survived and retained a coded wire tag was required to estimate the 1994 smolt abundance. Short-term survival and tag retention for smolt marked during each shift were estimated from a random sample of about 200 marked smolt that were detained in holding pens for 18 to 24 hours after marking.

Short-term survival rate ($\hat{s}_k$) for smolt marked and released during a marking shift was estimated as a binomial proportion by:

$$\hat{s}_k = \frac{d_k}{n_k}, \tag{1}$$

where:

$d_k$ = the number of smolt marked and detained during shift k that survived the detention period, and

$n_k$ = the number of marked smolt detained during shift k.

Short-term tag retention rate ($\hat{b}_k$) for smolt that were marked during a marking shift, survived, and retained tags was estimated similarly where:

$d_k$ = the number of marked smolt detained during shift k that survived the detention period and retained a tag, and

$n_k$ = the number of marked smolt detained during shift k that survived the detention period.

The total number ($\hat{q}_k$) of smolt that survived marking and retained a tag during each shift k was adjusted to account for mortality and tag loss as:

$$\hat{q}_k = N_k \hat{s}_k \hat{b}_k, \tag{2}$$

where:

$N_k$ = the number of smolt injected with a tag during shift k.

The total number of smolt marked at the Moose River in 1994 that survived and retained a tag was estimated by summing the individual estimates for each marking shift over the entire smolt emigration. The associated variance was considered to be zero because the tag retention and survival rate of all marked fish was 0.99.

## Estimating the Proportion of the Cohort Bearing Marks

Estimating the commercial harvest of coho salmon from the Kenai River in 1995 required estimating the proportion of the return marked with coded wire tags. This proportion was unknown at the time of smolt marking in 1994, but was estimated when adults returned in 1995. The inriver sport harvest was examined for marks and the proportion missing an adipose fin during each weekly interval i was estimated as a binomial proportion by (Cochran 1977):

$$\hat{y}_g = \frac{x_g}{n_g}, \tag{3}$$

where:

$x_g$ = the number of coho salmon observed missing the adipose fin during interval g, and

$n_g$ = the total number of coho salmon examined during interval g.

The proportion of coded wire tags from the 1994 Moose River release recovered from heads that were actually collected during each interval was also estimated by (Cochran 1977):

$$\hat{c}_g = \frac{v_g}{h_g}, \tag{4}$$

where:

$v_g$ = the number of tags recovered during interval g for coho salmon marked at the Moose River in 1994, and

$h_g$ = the number of heads collected from coho salmon missing the adipose fin during interval g.

A chi-square statistic was used to test the hypothesis that the proportion missing the adipose fin ($\hat{y}_g$) did not change over time, and to test the hypothesis that the proportion of fish of Moose River origin ($\hat{c}_g$) in the sample of collected heads ($h_g$) did not change over time. Based on inriver recoveries of marked coho salmon in 1993 (Carlon and Hasbrouck 1994) and 1994 (Carlon and Hasbrouck 1996), the a priori value of the proportion missing the adipose fin ($\hat{y}_g$) under the null hypothesis equaled 0.07. Sampling was designed to detect a difference of 0.02 from the hypothesized value among weekly recovery intervals at $\alpha = 0.05$ and power = $1 - \beta \geq 0.70$. Failure to reject these hypotheses would indicate that marked adults were representative of the return and would allow combining the inriver recovery data over all intervals to estimate the overall proportions $\hat{y}$ and $\hat{c}$ for the cohort. The overall marked proportion ($\hat{\theta}$) would then be estimated as the product of $\hat{y}$ and $\hat{c}$.

Estimation and hypothesis testing was therefore a two-step process. The first step involved sampling the inriver sport harvest to observe coho salmon missing the adipose fin. The second step occurred at the Tag Lab by decoding tags from heads collected from the sport harvest. The estimate of $\hat{\theta}$ therefore accounts for heads that were not collected from coho salmon missing the adipose fin.

The marking of smolt in 1994 and the subsequent recovery of marked adults from the inriver sport harvest in 1995 provided the data to estimate the number of smolt that emigrated from the Kenai River in 1994. The smolt emigration was estimated using the Chapman modified Lincoln-Petersen model (Seber 1982):

$$\hat{N} = \frac{(M+1)(C+1)}{(R+1)} - 1, \tag{5}$$

where:

M = the number of marked smolt emigrating with a coded wire tag in 1994,

C = the number of adult coho salmon examined in the sport harvest for a missing adipose fin, and

R = the number of adult coho salmon recovered from the sport harvest that were marked in the Kenai River.

The variance was estimated by:

$$V(\hat{N}) = \frac{(M+1)(C+1)(M-R)(C-R)}{(R+1)^2(R+2)}. \quad (6)$$

This model produces unbiased estimates of abundance if:

1. Adult coho salmon examined for marks were a random sample of the inriver return or the marked sample of smolt were a representative sample of the drainage-wide smolt emigration in 1994, and
2. All juveniles marked at the Moose River in 1994 were actually smolt, and
3. Survival and catchability were the same for marked and unmarked individuals, and
4. Tag code and release location were correctly determined for all fish observed with a missing adipose fin in the sport harvest, and
5. No tags were lost between the mark and recovery events.

The relationship between the return timing of marked adults and the time of smolt marking was investigated as an indicator of the degree of mixing of the return timing trait among smolt. A chi-square statistic was used to test the hypothesis that the return timing of adults marked as smolt was independent of the time of tagging. The hypothesis was tested at $\alpha = 0.05$ with the smolt sample divided into tag code groups representing the first 50% of the smolt marked (May 20-June 6, 1994) and the second 50% marked (June 7-June 20, 1994). The distributions of the recoveries of these two groups were compared over 2-week intervals during the adult return in August and September of 1995.

## Harvest Estimates

Estimates of commercial harvest of coho salmon of Kenai River origin were stratified by date corresponding to each fishery opening. The eastside set gillnet harvest was additionally stratified by statistical area. The drift gillnet harvest was not stratified by area because the harvest delivered to processors was often a mixture of fish harvested from more than one statistical area. Therefore, estimates of the harvest were made by opening date and area for the eastside set gillnet fishery and by opening date only for the drift gillnet fishery. The total harvest of Kenai River coho salmon by each fishery was estimated by summing estimates of each stratum. Because strata were considered independent, the variance of total harvest was calculated by summing strata variances. Although the primary study objective was to provide total inseason harvest estimates, daily estimates provided useful temporal trend information. The Commercial Fish Ticketing System managed by the ADF&G, Commercial Fisheries Management and Development (CFMD) Division provided the commercial harvest by fishery, date, and statistical area.

Commercial harvest of coho salmon of Kenai River origin was estimated while total harvest, number examined for marks, and number of coded wire tags (CWTs) recovered was considered known. The proportion of the return bearing marks was estimated by sampling the inriver harvest of returning adults. Harvest of coho salmon from population j in each commercial fishery stratum was estimated by (Bernard and Clark 1996):

$$\hat{r}_{ij} = N_i \theta_j^{-1} \left( \frac{m_{ij}}{\lambda_i n_i} \right), \tag{7}$$

where:

$N_i$ = total number of coho salmon harvested in stratum i,

$\theta_j$ = proportion of the 1995 Kenai River return (population j) marked with CWTs,

$m_{ij}$ = number of decoded CWTs recovered from population j in commercial fishery stratum i,

$n_i$ = number of fish harvested during stratum i examined for a missing adipose fin,

$\lambda_i = \frac{a_i' t_i'}{a_i t_i}$,

$a_i$ = number of heads collected from stratum i from fish with a missing adipose fin,

$a'_i$ = number of heads from stratum i that arrive at the Tag Lab,

$t_i$ = number of heads from stratum i with CWTs detected, and

$t'_i$ = number of CWTs found and decoded.

This estimator is statistically unbiased when sampling is from a simple random or pseudo-random process (Clark and Bernard 1987). When $\theta_j$ is estimated the large-sample approximation of the variance of commercial harvest is (Bernard and Clark 1996):

$$V(\hat{r}_{ij}) = \hat{r}_{ij}^2 \left[ G(\hat{p}_{ij}) + G(\hat{\theta}_j^{-1}) - G(\hat{p}_{ij}) G(\hat{\theta}_j^{-1}) \right], \tag{8}$$

where:

$$G(\hat{p}_{ij}) = \frac{1 - \lambda_i \phi_i \hat{\theta}_j}{m_{ij}},$$

$$\phi_i = \frac{n_i}{N_i}, \text{ and}$$

$$G(\hat{\theta}_j^{-1}) = \frac{V(\hat{\theta}_j^{-1})}{\hat{\theta}_j^{-2}}.$$

Although the number of fish harvested is estimated by commercial processors as a product of pounds purchased and average weight per fish, the overall variance of the number harvested is considered small because the entire harvest is weighed. Therefore, for the purpose of estimating the harvest of coho salmon of Kenai River origin, the number of coho salmon harvested by fishery was considered a known constant, not an estimate. However, the variance component associated with estimated average weight is not known because data used to calculate average weight is not reported by processors. Because the variance is not known, it is not included in the variance associated with 1995 harvest estimates; the extent of this variance component could be measured in the future based on data collected by ADF&G harvest sampling personnel.

Harvest estimates were based on sample data pooled among processors; bias associated with this pooling is probably insignificant because of the similarity of the marked proportion among intensively sampled processors, both for all marked fish (Figure 5) and for fish tagged at the Moose River in 1994 (Figure 6). Processors handling the most fish were sampled most intensively. Among the intensively sampled processors, the marked proportion (comprised of both Kenai River and hatchery-specific marks) ranged between 0.025 and 0.060 for harvests from the Central District driftnet and setnet fisheries and from the Northern District setnet fisheries (Figure 5). The marked proportion comprised of Kenai River-specific marks (1994 Moose River CWTs) ranged between 0.006 and 0.053 for the two Central District fisheries (Figure 6). At processors handling fewer fish or with low sampling intensity, such as processor "Y," marked proportions were outside this range, probably because of small sample sizes (Figures 5 and 6). Also, in 1993 and 1994, the estimates of harvest of Kenai River coho salmon based on data pooled among processors did not differ significantly from estimates based on data stratified by processor (Carlon and Hasbrouck 1996). Therefore, pooling data among processors in 1995 should improve precision of harvest estimates without introducing significant bias.

The harvest of coho salmon from the Kenai River was estimated for dates on which the commercial harvest was not sampled by combining the harvest on the unsampled date with the harvest occurring on the nearest sampled date. Accounting for unsampled dates in this way allows for comparisons of total harvest estimates among years regardless of unsampled dates.

# RESULTS

## JUVENILE MARKING: 1994

Smolt were marked with coded wire tags and adipose finclips as they emigrated from the Moose River during May 20 through June 20, 1994 (Appendix A1). An estimated 170,058 of the 171,811 marked smolt survived and retained tags based on estimates of short-term survival and tag retention.

## SPORT FISHERY: 1995

### Sampling and Mark Recovery

From August 2 through September 30, 1995, we examined 4,838 sport-harvested coho salmon (Table 1 and Appendix A2). Heads were recovered from 998 of the 1,355 adipose-clipped adults observed. Of the 998 heads processed at the Tag Lab, 963 (96%) were marked as smolt at the Moose River in 1994. Tags were missing from 29 (3%) of the recovered heads. The remaining 5 recoveries from the sport harvest included 3 fish tagged at the Moose River during the spring of 1995 and 2 hatchery-produced fish originally released as smolt in Ship Creek in 1994. An additional 26 coho salmon heads were voluntarily delivered by anglers to department personnel. Of these, 24 contained tags, all of which were implanted at the Moose River in 1994.

### Proportion of the Cohort Bearing Marks

Due to a large flood, most sport angling in the Kenai River ceased from September 21 through September 27 and only 19 fish were examined between September 28 and September 30. Weekly variation in the marked proportion was therefore examined during the period August 1 through September 20, 1995. However, the sample from which the overall marked proportion was estimated included the 19 fish examined during the last 3 days of September.

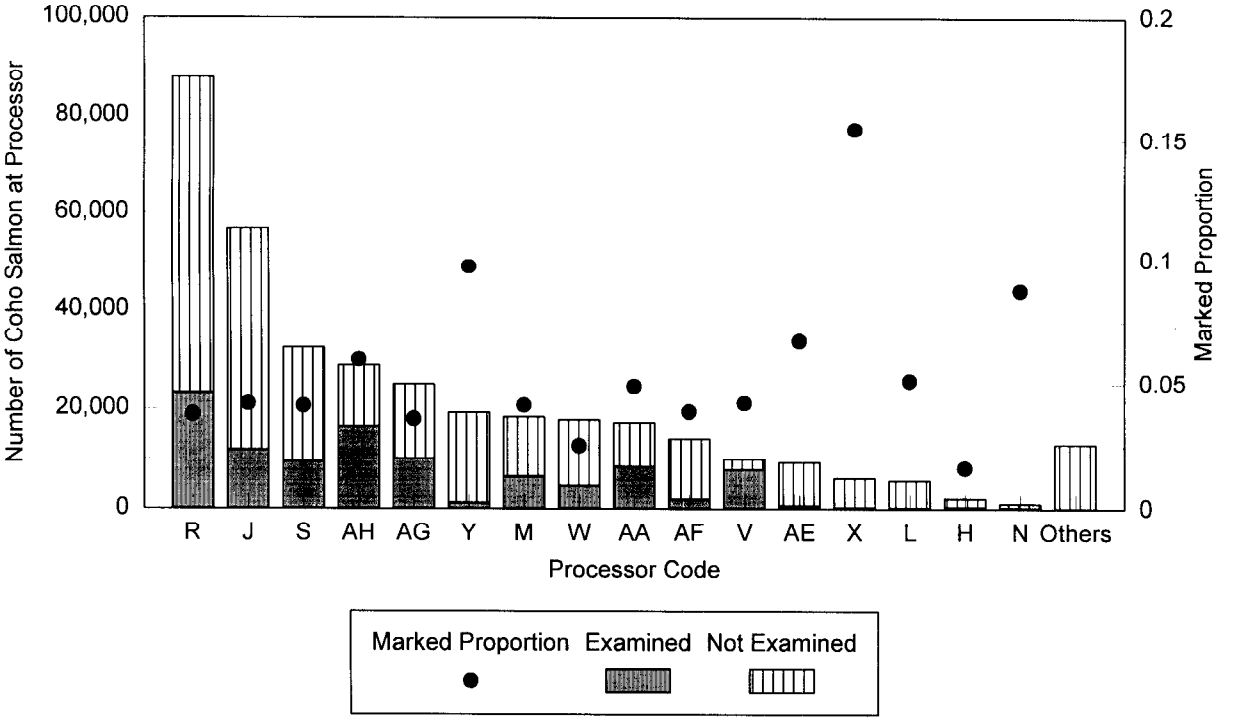



**Figure 5.-Number of coho salmon harvested in the Central District drift gillnet, Central District East Side set gillnet, and Northern District set gillnet fisheries that were examined or not examined for missing adipose fins at 16 Upper Cook Inlet processors in 1995, and proportion of those examined coho salmon that had missing adipose fins (all cohorts). "Other" processor category represents 18 additional processors that were not sampled.**

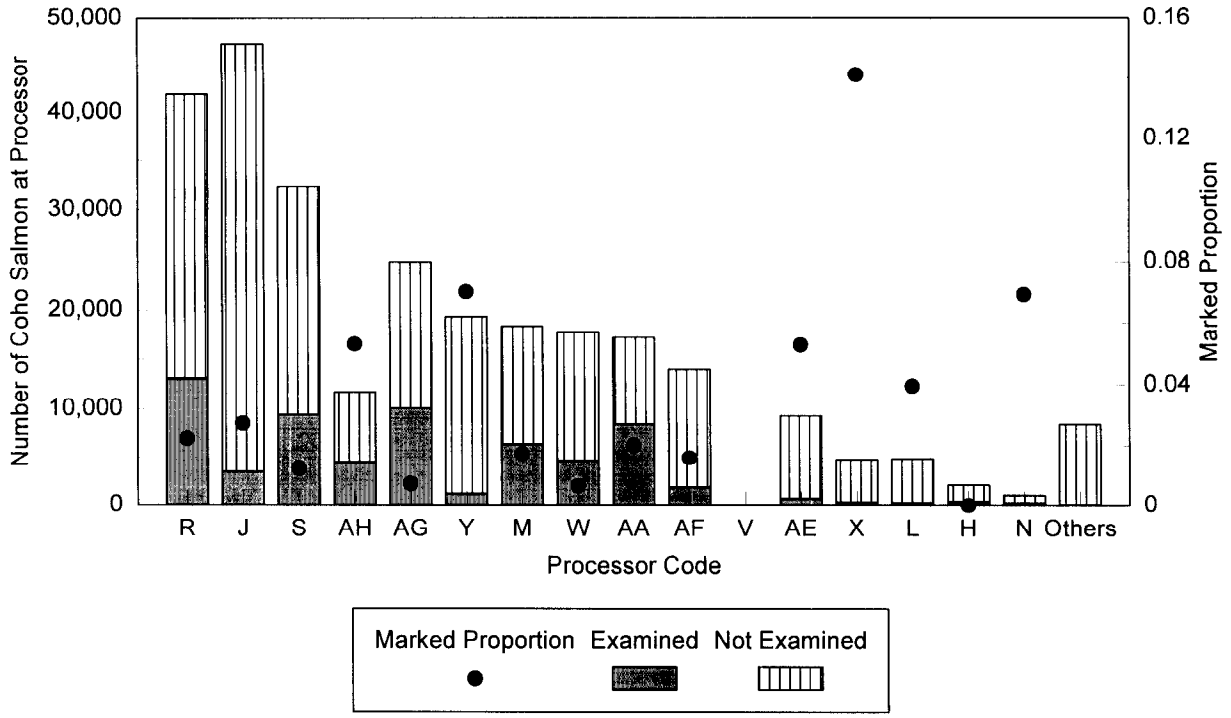



**Figure 6.-Number of coho salmon harvested in the Central District drift gillnet and Central District East Side set gillnet fisheries that were examined or not examined for coded wire tags at 16 Upper Cook Inlet processors in 1995, and proportion of those examined coho salmon that were tagged with coded wire tags in Moose River in 1994. "Other" processor category represents 18 additional processors that were not sampled.**

**Table 1.-Sources of marked coho salmon adults recovered at random from the Kenai River sport harvest by week, August through September, 1995.**

| Period | | Number Examined | Marked Fish Observed | $y_i$ [a] | Marked Fish Recovered | Source = Moose R. 1994 | $c_i$ [b] | $Theta_i$ | Other Sources: CWT Missing | Other Sources: Moose R. 1995 | Other Sources: Ship Crk 1994 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 8/01-8/07 | | 299 | 74 | 0.247 | 50 | 50 | 1.000 | 0.247 | | | |
| 8/08-8/14 | | 593 | 161 | 0.272 | 93 | 92 | 0.989 | 0.269 | 1 | | |
| 8/15-8/21 | | 1152 | 220 | 0.191 | 174 | 166 | 0.954 | 0.182 | 7 | | 1 |
| 8/22-8/28 | | 618 | 177 | 0.286 | 142 | 133 | 0.937 | 0.268 | 7 | 1 | |
| 8/29-9/04 | | 686 | 233 | 0.340 | 176 | 170 | 0.966 | 0.328 | 3 | 2 | 1 |
| 9/05-9/11 | | 780 | 254 | 0.326 | 180 | 176 | 0.978 | 0.318 | 4 | | |
| 9/12-9/20 | [c] | 691 | 228 | 0.330 | 178 | 171 | 0.961 | 0.317 | 7 | | |
| 9/28-9/30 | [c] | 19 | 8 | 0.421 | 5 | 5 | 1.000 | 0.421 | | | |
| Grand | | 4,838 | 1,355 | 0.280 | 998 | 963 | 0.965 | 0.270 | 29 | 3 | 2 |

[a] Proportion of examined fish that were found with an adipose finclip mark.

[b] Proportion of marked fish recovered that were originally marked at the Moose River in 1994 based on recovery of the coded wire tag.

[c] Virtually all angler activity ceased after August 20 due to an extreme flood.

The proportion of adipose-clipped fish in the sport harvest differed significantly ($\chi^2 = 76.0$, df = 6, $P < 0.001$) among weekly intervals although a trend or major fluctuation in the proportion was absent. The return timing of adults was independent of time of marking as smolt at the Moose River in 1994 ($\chi^2 = 2.77$, df = 3, P = 0.43) (Appendices A3 and A4) and all tag codes released at the Moose River were observed in the adult return. The detection of a statistical difference in the marked proportion among weeks was due in part to large sample sizes and the resultant statistical power. Therefore, pooling inriver recovery data to estimate the marked proportion would not introduce consequential bias in final estimates of commercial harvest. The data were therefore pooled for this purpose and the marked proportion ($\hat{\theta}$) of the Kenai River cohort returning in 1995 was estimated as 0.270 [$V(\hat{\theta}^{-1}) = 0.0117$]. To determine if pooling would introduce bias that would substantially influence final estimates of commercial harvest, a sensitivity analysis was performed and is presented in the Discussion Section.

The abundance of all smolt emigrating from the Kenai River in 1994 was also estimated based on the pooled inriver recovery data. Based on the number of smolt marked at the Moose River in 1994 (170,058), the number of adult coho salmon examined for marks in the Kenai River sport harvest in 1995 (4,838), and the estimated number of tagged adults recovered that were marked at the Moose River in 1994 (1,307), an estimated 628,909 (SE = 14,788) smolt emigrated from the Kenai River in 1994.

## COMMERCIAL FISHERIES: 1995

### Sampling and Mark Recovery

Commercial fishery sampling is summarized in detail for the target fisheries of the Central District (drift and eastside set). General inlet-wide sampling is also summarized to add perspective and to document the recovery of marked coho salmon from the Kenai River in other areas of Cook Inlet. Additional details of the Northern District sampling effort are documented in a companion report (Cyr et al. *In prep*).

### Inlet-Wide Fisheries

In 1995, 446,954 coho salmon were harvested in commercial fisheries of UCI. This harvest was 14% less than the average of the last 10 years and 23% greater than the long-term average since 1966 (Ruesch and Fox *In prep*). About 80% of the 1995 UCI commercial harvest was taken in Central District fisheries (Figure 7). The greatest harvest occurred in the drift gillnet fishery of the Central District (52%), followed by the set gillnet fishery on the west side of the Northern District (15%) and the Central District eastside set gillnet fishery (10%). The other seven fisheries accounted for 23% of the total harvest.

Of the inlet-wide harvest, 117,706 fish (26% of the total harvest) were examined for adipose clips (Table 2, Appendix A5). From these fish 5,018 (4%) adipose-clipped fish were found; heads were recovered from all but 34 fish. Adipose-clipped fish were found in all sampled fisheries. All recovered tags were from hatchery-produced fish released as juveniles in Cook Inlet or from juveniles marked within the Kenai River drainage. Of the 4,984 heads recovered, 397 (8%) had no tag.

A total of 1,564 tags recovered from commercially harvested adults were originally marked as juveniles in the Kenai River drainage. Virtually all (1,561) were marked as smolt at the Moose River in 1994. A single tag was recovered from a fish that was marked as a juvenile at the

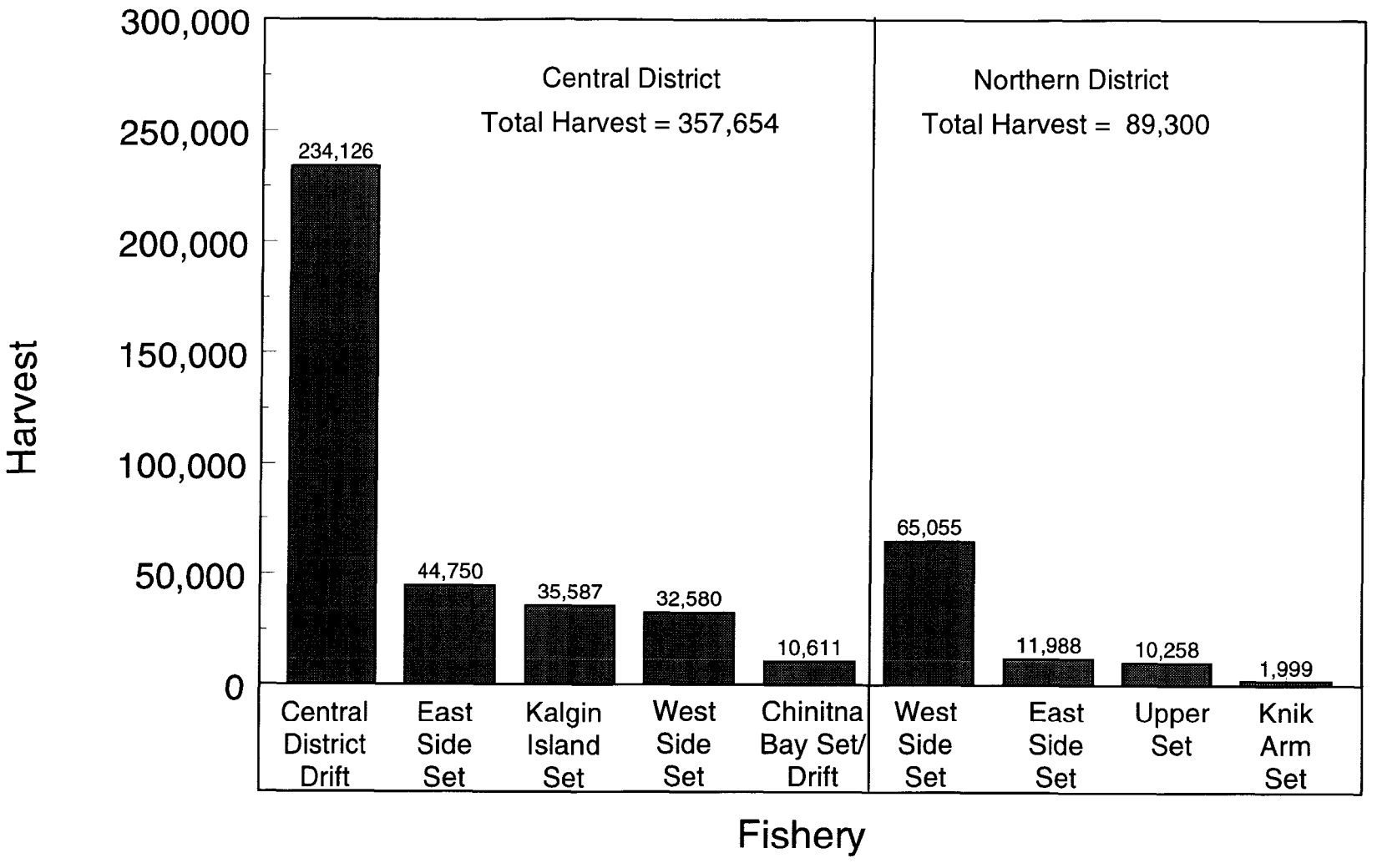



**Figure 7.-Coho salmon harvest in nine Upper Cook Inlet commercial fishery areas in 1995.**

**Table 2.-Summary of sampling effort and recovery of coded wire tags (CWT) from adipose-clipped coho salmon from Upper Cook Inlet commercial fisheries in 1995.**

| Gillnet Fishery | Harvest | Number Examined | Percent of Harvest Examined | Ad-clips Found | Heads Recovered | Missing CWT or Unreadable | Heads with Decodable CWT [a] | Number from cohort marked at Moose R. in 1994 |
|---|---|---|---|---|---|---|---|---|
| **CENTRAL DISTRICT** | | | | | | | | |
| Drift | 234,126 | 55,303 | 24 | 2,090 | 2,062 | 176 | 1,886 | 442 |
| East Side Set (by Statistical Area) | | | | | | | | |
| 244-21 | 6,376 | 1,654 | 26 | 166 | 165 | 8 | 157 | 151 |
| 244-22 | 8,618 | 2,820 | 33 | 375 | 375 | 12 | 363 | 345 |
| 244-30 | 12,142 | 1,273 | 10 | 157 | 156 | 9 | 147 | 135 |
| 244-40 | 17,614 | 2,905 | 16 | 247 | 246 | 16 | 230 | 183 |
| East Side Set Total | 44,750 | 8,652 | 19 | 945 | 942 | 45 | 897 | 814 |
| Kalgin Is. Set | 35,587 | 4,948 | 14 | 128 | 128 | 13 | 115 | 19 |
| West Side Set | 32,580 | 1,169 | 4 | 7 | 7 | 2 | 5 | 0 |
| Chinitna Bay Set/Drift | 10,611 | 465 | 4 | 2 | 2 | 2 | 0 | 0 |
| Mixed East Side Set Stat. Areas [b] | | 1,070 | | 113 | 113 | 2 | 111 | 89 |
| Mixed Central District Fisheries [c] | | 6,740 | | 252 | 252 | 20 | 232 | 94 |
| **Central District Total** | 357,654 | 78,347 | 22 | 3,537 | 3,506 | 260 | 3,246 | 1,458 |

-continued-

**Table 2.-Page 2 of 2.**

| Gillnet Fishery | Harvest | Number Examined | Percent of Harvest Examined | Ad-clips Found | Heads Recovered | Missing CWT or Unreadable | Heads with Decodable CWT [a] | Number from cohort marked at Moose R. in 1994 |
|---|---|---|---|---|---|---|---|---|
| | | | | **NORTHERN DISTRICT** | | | | |
| West Side Set | 65,055 | 23,573 | 36 | 413 | 411 | 60 | 351 | 38 |
| East Side Set | 11,988 | 9,381 | 78 | 355 | 354 | 29 | 325 | 45 |
| Fire Is. Set | 6,012 | 2,864 | 48 | 444 | 444 | 35 | 409 | 7 |
| Pt. MacKenzie/Su Flats Set | 4,246 | 2,427 | 57 | 218 | 218 | 7 | 211 | 7 |
| Knik Arm Set | 1,999 | 0 | 0 | | | | | |
| Mixed Northern District Fisheries [d] | | 124 | | 3 | 3 | 0 | 3 | 0 |
| **Northern District Total** | 89,300 | 38,369 | 43 | 1,433 | 1,430 | 131 | 1,299 | 97 |
| | | | | **MIXED NORTHERN AND CENTRAL DISTRICTS** | | | | |
| **Northern and Central Mixed Fisheries** [e] | | 990 | | 48 | 48 | 6 | 42 | 6 |
| **Grand Total** | 446,954 | 117,706 | 26 | 5,018 | 4,984 | 397 | 4,587 | 1,561 |

[a] Includes marked fish released in the Kenai River and at other Cook Inlet release locations.

[b] Examined fish were from a mixture of Central District eastside set net fishery statistical areas.

[c] Examined fish were from a mixture of fish harvested in the Central District drift, eastside set, Chinitna Bay set and drift, and Kalgin Island set net fisheries.

[d] Examined fish were from a mixture of fish harvested in the Northern District west and eastside set net fisheries.

[e] Examined fish were from a mixture of fish harvested in Central and Northern District Fisheries.

Moose River in 1993 and apparently did not smolt in that year. The remaining two tags were recovered from fish that were captured and marked as fingerling at the outlet of Skilak Lake in the fall of 1992 (Carlon and Hasbrouck 1993). Most (93%) of the Moose River tag recoveries were from Central District fisheries.

### Central District Drift Gillnet Fishery

Harvest of the Central District drift gillnet fishery was sampled during most openings between July 7 and August 14 (Figure 8, Appendix A5). Overall, 24% of the harvest was examined (Table 2). The harvest occurring on days not sampled accounted for 5% of the total harvest.

The first recoveries of fish tagged at Moose River were made on July 17, 10 days after sampling began. Coho salmon marked at the Moose River were recovered on all sampled days between July 18 and August 14. Of all fish examined, 0.8% were marked as smolt at the Moose River in 1994.

### Central District Eastside Set Gillnet Fishery

Harvest in the Central District eastside set gillnet fishery was sampled during most fishing periods from July 14 through August 14 (Figure 9, Appendix A5). Overall, 19% of the harvest was examined (Table 2). Over 33% of the harvest from area 244-22 was examined, while a lesser portion of the harvest occurring in the other areas was examined. The harvest occurring on unsampled days was 16% of the total fishery harvest. Among statistical areas, the portion of the harvest occurring on unsampled days ranged from 11% to 19% (Figure 10).

Coho salmon marked at the Moose River in 1994 were recovered from all four statistical areas in 1995. The first recovery of Moose River marks occurred on July 17 in statistical areas 244-22, 244-30, and 244-40. This was the second sampled fishing period in 1995. The first recovery of marked fish in statistical area 244-21 did not occur until July 24. However, few fish were harvested (553) or examined (56) prior to this date. The portions of fish examined in 1995 that were marked at the Moose River in 1994 were 9%, 12%, 11%, and 6% for statistical areas 244-21, 244-22, 244-30, and 244-40, respectively.

## Commercial Harvest Estimates

An estimated 6,956 (SE = 347) coho salmon of Kenai River origin were harvested by the drift gillnet fishery and 13,165 (SE = 586) by the eastside set gillnet fishery, for a total of 20,121 (SE = 681) during 1995 (Tables 3 and 4). Coho salmon of Kenai River origin made up 3% of the total drift gillnet harvest and 29% of the total eastside set gillnet harvest in 1995.

The harvest occurring in the drift gillnet fishery before the first coho salmon from the Kenai River were detected on July 17 was 22% (52,536 coho salmon) of the total harvest. Over 96% of the harvest of coho salmon of Kenai River origin occurred during the 3-week period between July 24 and August 14. There was an increasing temporal trend in the portion of the harvest that was Kenai River fish (Figure 11). Although the greatest proportional contribution (19%) occurred during the second week of August (just prior to the end of inlet-wide fishing), the greatest absolute harvest occurred earlier, during the period July 30 through August 5 (Figure 11).

The harvest occurring in the eastside set gillnet fishery before the first coho salmon from the Kenai River were detected on July 17 was 8% (3,521 coho salmon) of the total harvest. Coho salmon from the Kenai River made up a greater portion of the harvest after July 29 in all

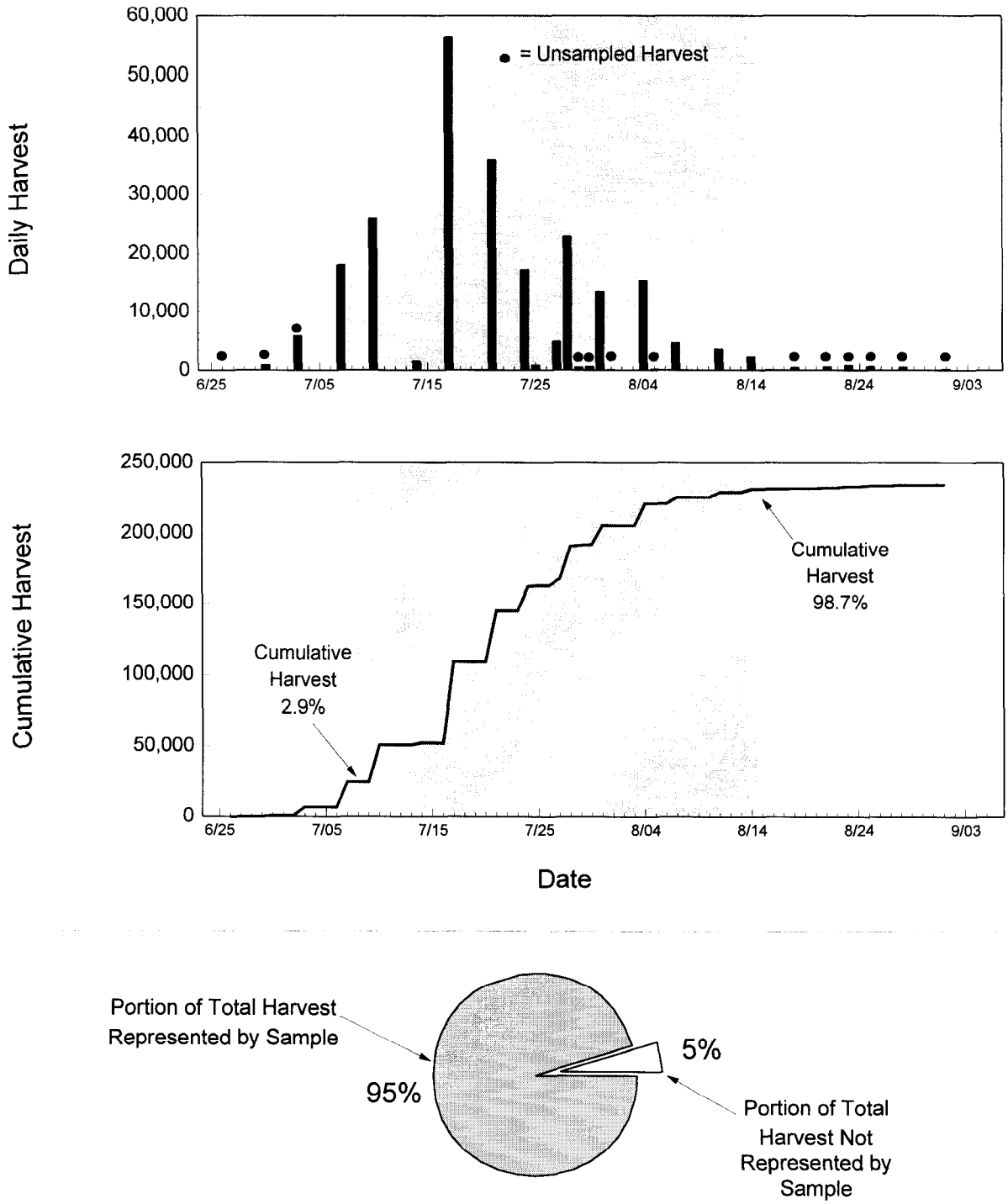



**Figure 8.-Coho salmon harvest and sampling performance occurring in the Upper Cook Inlet Central District drift gillnet fishery in 1995. Shaded region represents the time period during which the harvest was examined.**

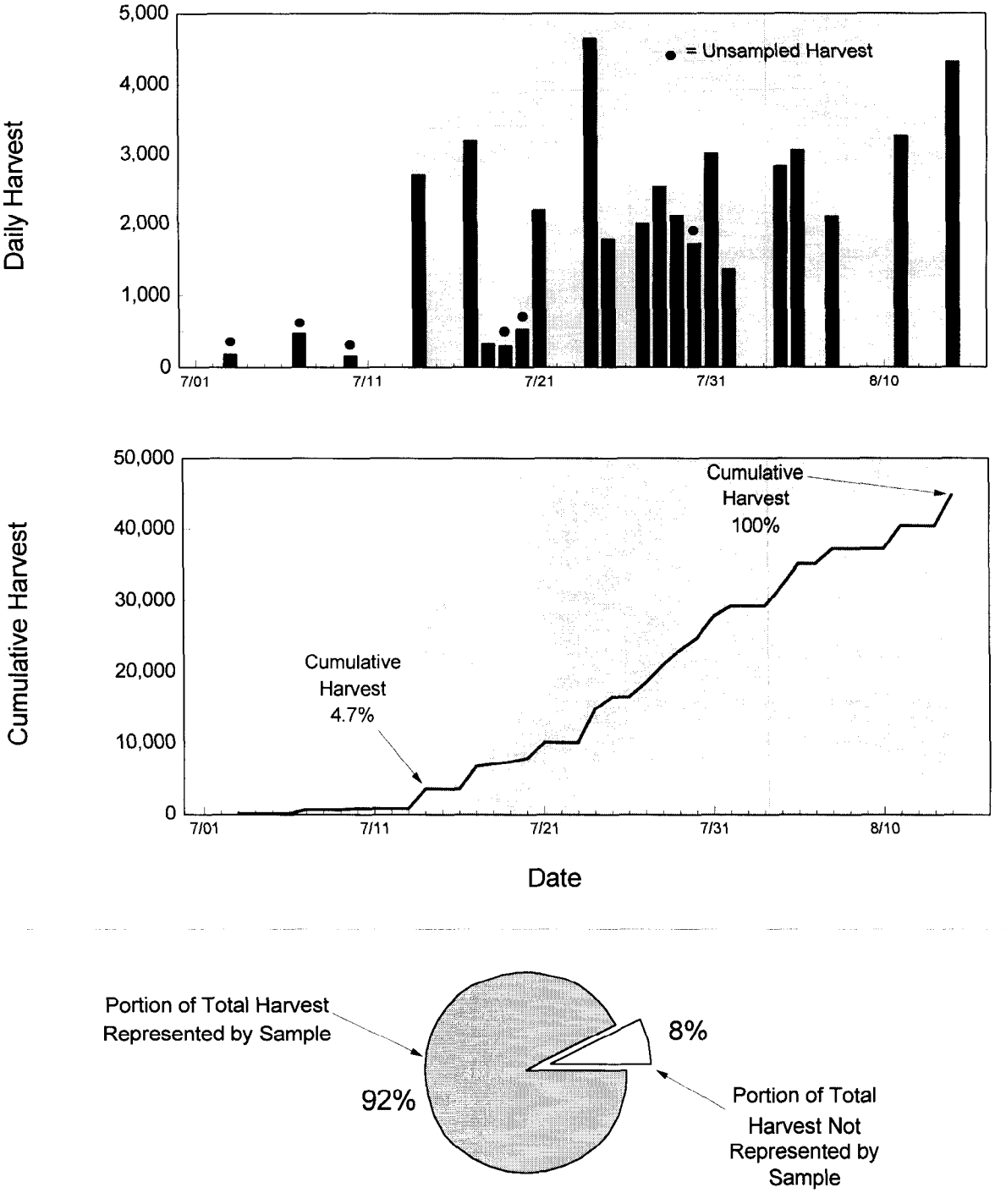



**Figure 9.-Coho salmon harvest and sampling performance occurring in the Upper Cook Inlet Central District eastside set gillnet fishery in 1995. Shaded region represents the time period during which the harvest was examined.**

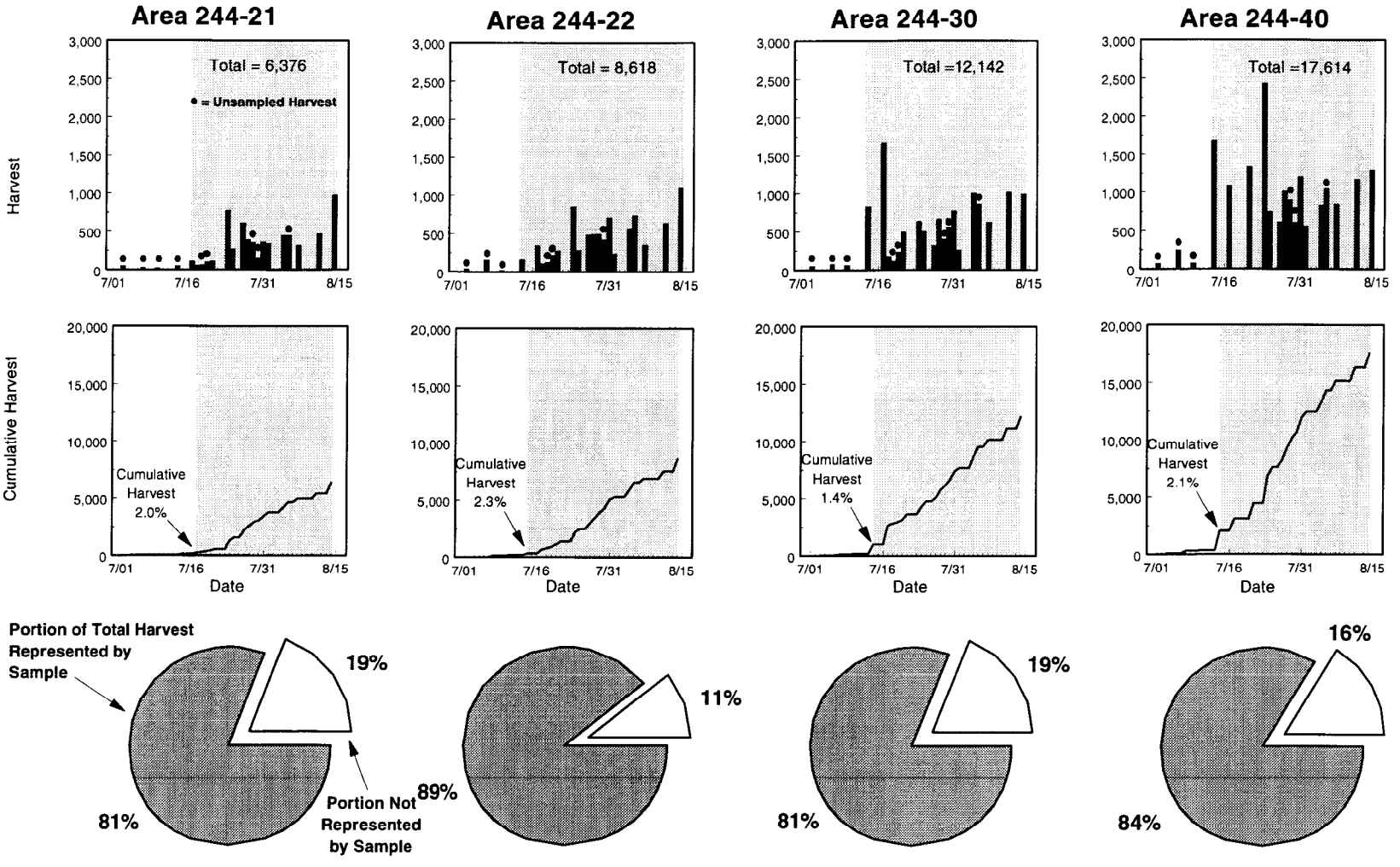



**Figure 10.-Coho salmon harvest and sampling performance occurring in the Upper Cook Inlet Central District eastside set gillnet fishery by statistical area in 1995. Shaded region represents the time period during which the harvest was examined.**

**Table 3.-Estimated harvest of coho salmon of Kenai River origin in the commercial drift gillnet fishery of the Central District of Upper Cook Inlet during selected time intervals, 1995.**

| Period | Total Harvest | Estimated Harvest of Coho Salmon of Kenai River Origin | Percent of Total | Variance of Harvest Estimate | Relative Precision |
|---|---|---|---|---|---|
| 6/26 - 7/08 | 24,901 | 0 | 0.0% | 0 | |
| 7/09 - 7/15 | 27,635 | 0 | 0.0% | 0 | |
| 7/16 - 7/22 | 92,419 | 246 | 0.3% | 3,854 | 49.5% |
| 7/23 - 7/29 | 46,371 | 1,669 | 3.6% | 30,938 | 20.7% |
| 7/30 - 8/05 | 29,547 | 3,057 | 10.3% | 55,505 | 15.1% |
| 8/06 - 8/14 | 10,307 | 1,984 | 19.2% | 30,222 | 17.2% |
| 8/15 - 9/01 | 2,946 | N/A [a] | | | |
| Total | 234,126 | 6,956 | 3.0% | 120,519 | 9.8% |

[a] No fish were examined during this time interval.

statistical areas (Figure 12). In the southern two statistical areas, both the absolute harvest of coho salmon from the Kenai River and the proportion of the total harvest made up of coho salmon from the Kenai River were greatest from July 30 through August 5, while in the northern two statistical areas these two estimates were greatest during the last week of the season.

From the southernmost statistical area to the northernmost, there was an increasing trend in the total harvest and a general decreasing trend in the portion of the harvest made up of coho salmon from the Kenai River (Figure 13). However, the absolute harvest of Kenai River coho salmon was relatively similar among statistical areas.

# DISCUSSION

## COMMERCIAL HARVEST ESTIMATES

Accurate estimates of the commercial harvest of coho salmon from the Kenai River are dependent upon an accurate estimate of the marked proportion of adults as they migrate through commercial harvest areas. The marked proportion was estimated by pooling all observations of marked and unmarked fish examined in the inriver sport harvest even though a statistical difference was detected among weeks during August and September.

To determine the potential bias in commercial harvest estimates associated with pooling sport harvest observations, a sensitivity analysis was performed (Table 5). Three sets of commercial harvest estimates were calculated and examined for practical differences. Estimates were generated using the pooled (0.270), the minimum (0.182), and the maximum (0.328) marked proportions observed in the sport harvest during weekly intervals. The resulting minimum and maximum estimates can therefore be considered lower and upper bounds for bias and represent a worst-case scenario. Among the Central District drift gillnet fishery and each statistical area of the eastside set gillnet fishery, the resulting minimum and maximum harvest estimates differed

**Table 4.-Estimated harvest of coho salmon from the Kenai River in the eastside set gillnet fishery of Upper Cook Inlet by statistical area and selected time periods, 1995.**

| | Statistical Area 244-21 | | | | Statistical Area 244-22 | | | | Statistical Area 244-30 | | | | Statistical Area 244-40 | | | | Total | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Period | Total Harv. | Est. Harv. | Var. | R.P.[a] | Total Harv. | Est. Harv. | Var. | R.P.[a] | Total Harv. | Est. Harv. | Var. | R.P.[a] | Total Harv. | Est. Harv. | Var. | R.P.a | Total Harv. | Est. Harv. | Var. | R.P.[a] |
| 7/03-7/15 | 126 | 0 | 0 | | 356 | 0 | 0 | | 992 | 0 | 0 | | 2,047 | 0 | 0 | | 3,521 | 0 | 0 | |
| 7/16-7/22 | 427 | 0 | 0 | | 1,036 | 124 | 4,594 | 107.1% | 2,658 | 208 | 24,406 | 147.2% | 2,415 | 62 | 1,418 | 119.0% | 6,536 | 394 | 30,418 | 86.8% |
| 7/23-7/29 | 2,363 | 551 | 9,437 | 34.6% | 2,553 | 595 | 7,925 | 29.3% | 2,482 | 785 | 44,098 | 52.4% | 5,657 | 458 | 27,993 | 71.6% | 13,055 | 2,389 | 89,453 | 24.5% |
| 7/30-8/05 | 1,728 | 1,046 | 17,816 | 25.0% | 2,623 | 1,580 | 18,149 | 16.7% | 3,405 | 1,215 | 70,261 | 42.8% | 4,203 | 1,433 | 33,080 | 24.9% | 11,959 | 5,274 | 139,306 | 13.9% |
| 8/06-8/14 | 1,732 | 470 | 4,644 | 28.4% | 2,050 | 1,004 | 7,894 | 17.3% | 2,605 | 1,720 | 32,293 | 20.5% | 3,292 | 1,914 | 39,603 | 20.4% | 9,679 | 5,108 | 84,434 | 11.1% |
| Total | 6,376 | 2,067 | 31,897 | 16.9% | 8,618 | 3,303 | 38,562 | 11.7% | 12,142 | 3,928 | 171,058 | 20.6% | 17,614 | 3,867 | 102,094 | 16.2% | 44,750 | 13,165 | 343,611 | 8.7% |

[a] Relative precision of estimated harvest.

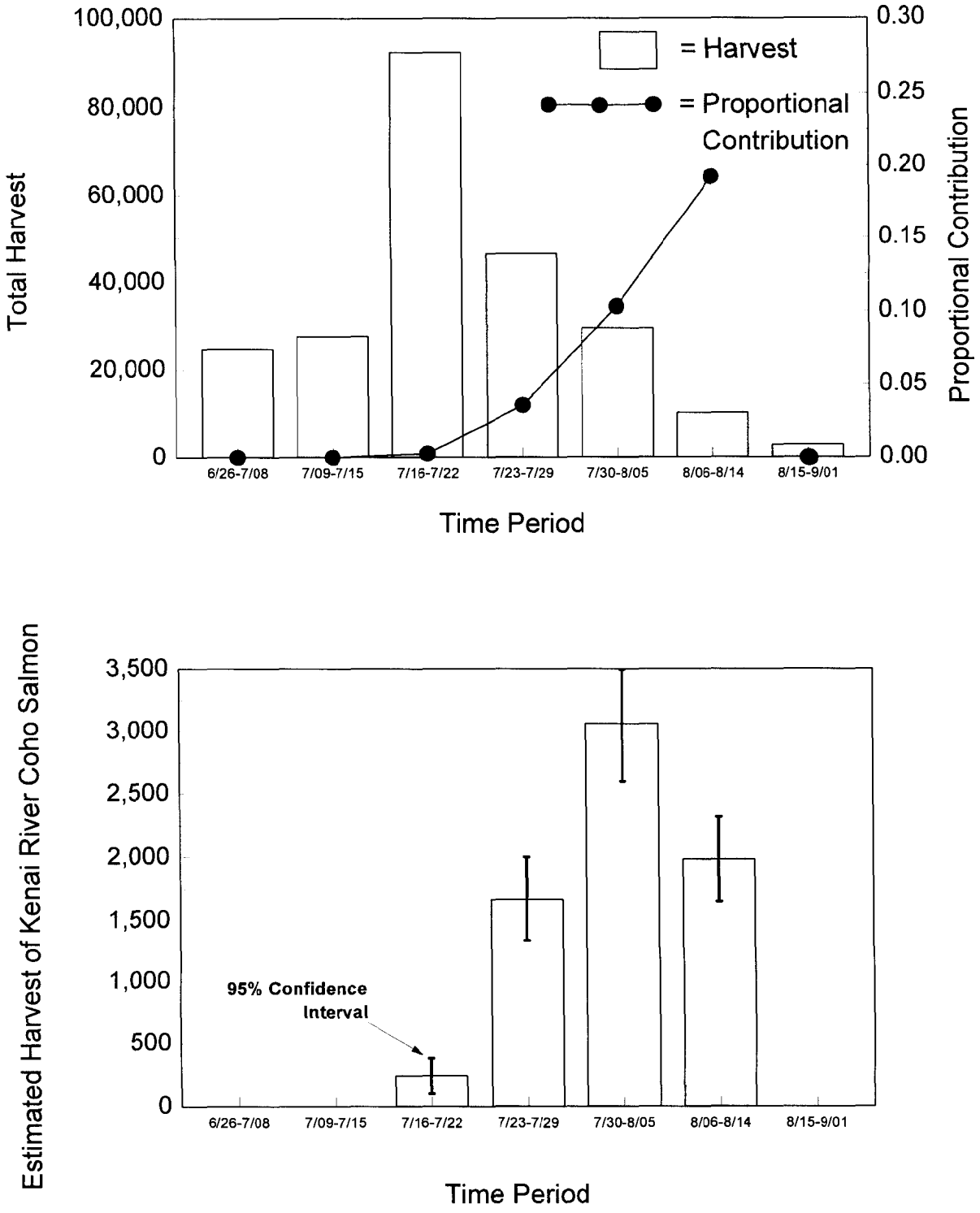



**Figure 11.-Trend in proportional contribution of Kenai River coho salmon to the total harvest (top) and trend in absolute contribution (bottom) occurring in the drift gillnet fishery of the Central District of Upper Cook Inlet, 1995.**

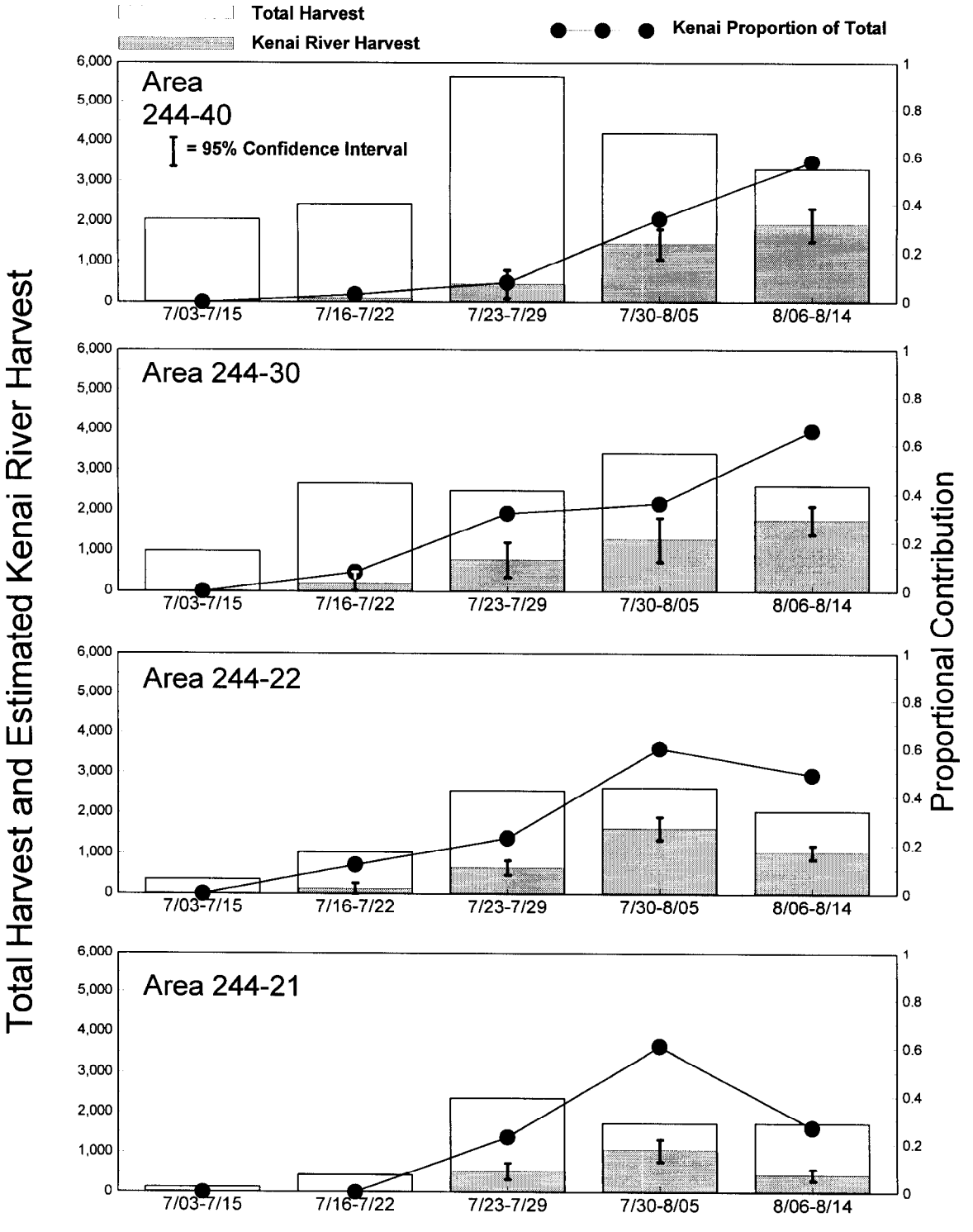



**Figure 12.-Trends in proportional and absolute contribution of coho salmon from the Kenai River to the total harvest of coho salmon occurring in four statistical areas of the Upper Cook Inlet Central District eastside set gillnet fishery during five time periods in 1995.**

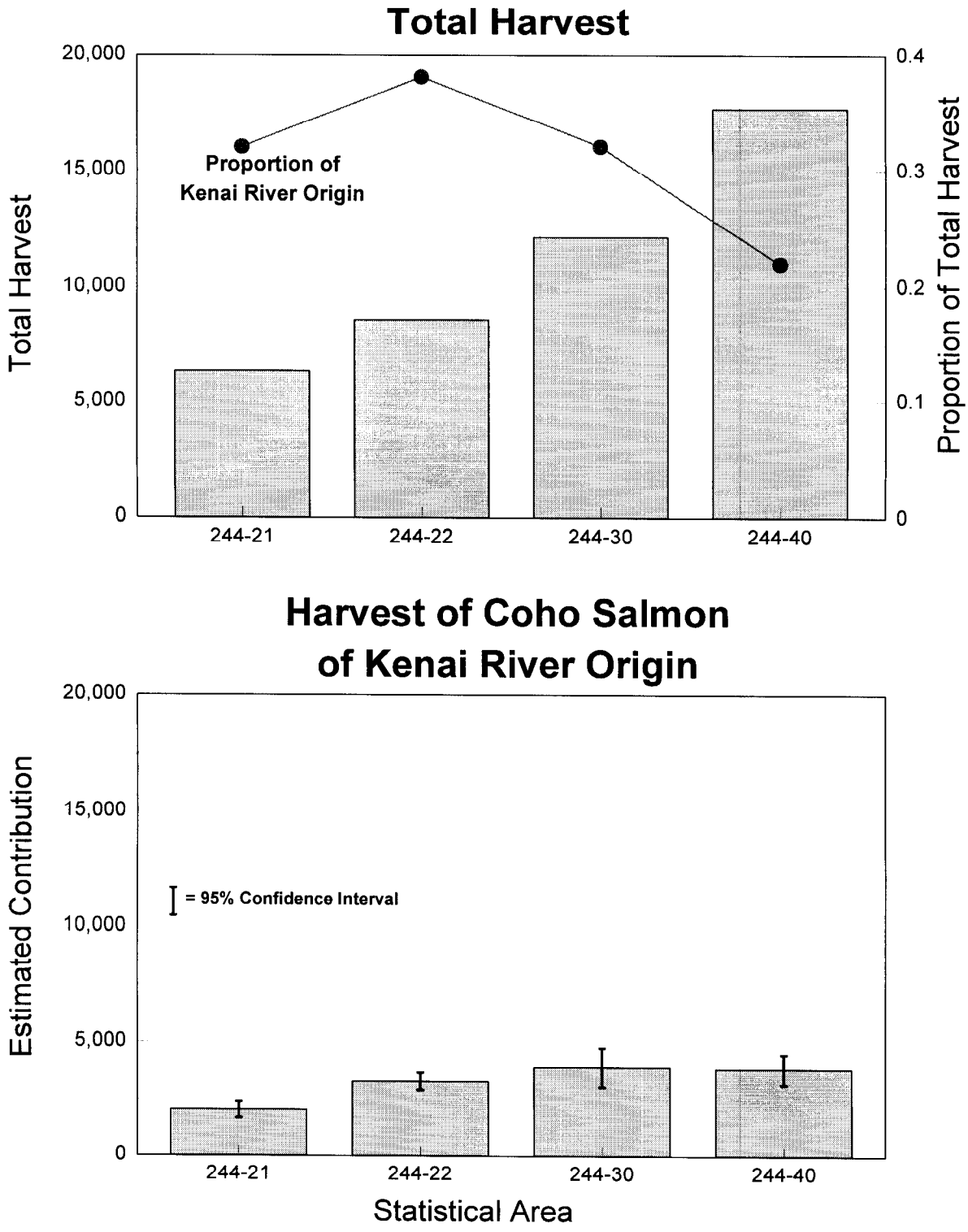



**Figure 13.-Geographic trends in total coho salmon (top) and in estimated number of coho salmon of Kenai River origin (bottom) harvested among statistical areas in the eastside set gillnet fishery of the Central District of Upper Cook Inlet, 1995.**

**Table 5.-Sensitivity of commercial harvest estimates to maximum variations in the marked proportion observed in coho salmon from the Kenai River in 1995.**

| Cental District Fishery | Total Harvest | Pooled Marked Proportion (0.270) Estimated Harvest | Minimum Observed Marked Proportion (0.182) Estimated Harvest | Difference From Pooled | % Difference From Pooled | Difference from Pooled as % of Total Harvest | Maximum Observed Marked Proportion (0.328) Estimated Harvest | Difference From Pooled | Percent Difference | Difference from Pooled as % of Total Harvest |
|---|---|---|---|---|---|---|---|---|---|---|
| Drift | 234,126 | 6,956 | 10,320 | 3,364 | 48% | 1% | 5,726 | 1,230 | 18% | 1% |
| 244-21 | 6,376 | 2,067 | 3,067 | 1,000 | 48% | 16% | 1,702 | 366 | 18% | 6% |
| 244-22 | 8,618 | 3,303 | 4,900 | 1,597 | 48% | 19% | 2,719 | 584 | 18% | 7% |
| 244-30 | 12,142 | 3,928 | 5,827 | 1,899 | 48% | 16% | 3,233 | 695 | 18% | 6% |
| 244-40 | 17,614 | 3,867 | 5,737 | 1,870 | 48% | 11% | 3,184 | 684 | 18% | 4% |
| East Side Total | 44,750 | 13,165 | 19,531 | 6,366 | 48% | 14% | 10,837 | 2,328 | 18% | 5% |
| Drift + East Side | 278,876 | 20,122 | 29,851 | 9,729 | 48% | 3% | 16,564 | 3,558 | 18% | 1% |

from the pooled estimate by 18% and 48%, respectively. The maximum difference from the pooled estimates represented 1% of the total drift gillnet harvest and 14% of the total eastside set gillnet harvest. Based on these worst-case percent differences, bias in estimates of commercial harvest associated with pooling all sport harvest samples to estimate the marked proportion are assumed to be minor. The estimates as presented are therefore considered practical for current management and research needs.

The combined drift and eastside set gillnet harvest of 20,121 coho salmon in 1995 was between the 1993 estimate of 7,736 fish (Carlon and Hasbrouck 1994) and the 1994 estimate of 26,405 fish (Carlon and Hasbrouck 1996). All three estimates were lower than expected given the proximity of fishing effort to the mouth of the Kenai River. The estimates were also relatively similar considering that the range in total harvest in these fisheries was 208,356 fish among years. Also similar among years were the portions of each fishery harvest that were of Kenai River origin (Figure 14). In all 3 years, Kenai River fish were a minority of the total harvest. The similarity among years was unexpected, especially in mixed-stock, mixed-species fisheries where management actions differ substantially among years. Despite these similarities, it is too early to conclude that the Kenai River contribution to the harvest is consistently low. Additional estimates of the stock-specific commercial harvest are necessary to provide insight into the variability of the commercial harvest of coho salmon from the Kenai River.

The study of population-specific harvest and smolt abundance demonstrates a potential concern for the coho salmon resource of the Kenai River. The estimate of about 629,000 smolt in 1994 is the lowest of the three currently available estimates (1992 through 1994). The total harvests (sport, commercial, personal use, and subsistence) in 1993 and 1994 were estimated as approximately 60,000 and 118,000 coho salmon, respectively. The 1994 estimate of 118,000 fish demonstrates the harvest potential of existing fisheries. If this harvest potential is realized during a return produced from a smolt abundance similar to 629,000, an extremely high exploitation rate may occur if marine survival of smolt approximates 20% as has been estimated for wild coho salmon stocks in Alaska's Taku River (McPherson et al. 1994; McPherson and Bernard 1994). Exploitation rate for the Kenai River population has not been estimated because the escapement is unknown; a specific conservation concern associated with these harvest levels has therefore not been quantified. However, without estimates of exploitation or a more extensive record of total harvests, there is currently no perspective from which to determine the sustainability of the harvests estimated in 1993 and 1994.

## SMOLT ESTIMATES

The estimated 628,909 smolt emigrating from the Kenai River in 1994 was 32% less than the average emigration of 879,290 smolt in 1992 (Carlon and Hasbrouck 1994) and 977,964 smolt in 1993 (Carlon and Hasbrouck 1996). As with the estimates of total fishing mortality, there is no historical perspective to determine the biological significance of this decrease. Factors influencing the decrease are unknown. These differences may merely reflect natural variability in freshwater production and the compensatory nature of smolt-to-adult survival. A long-term commitment to estimate smolt abundance is necessary for this to become a practical tool in developing management strategies.

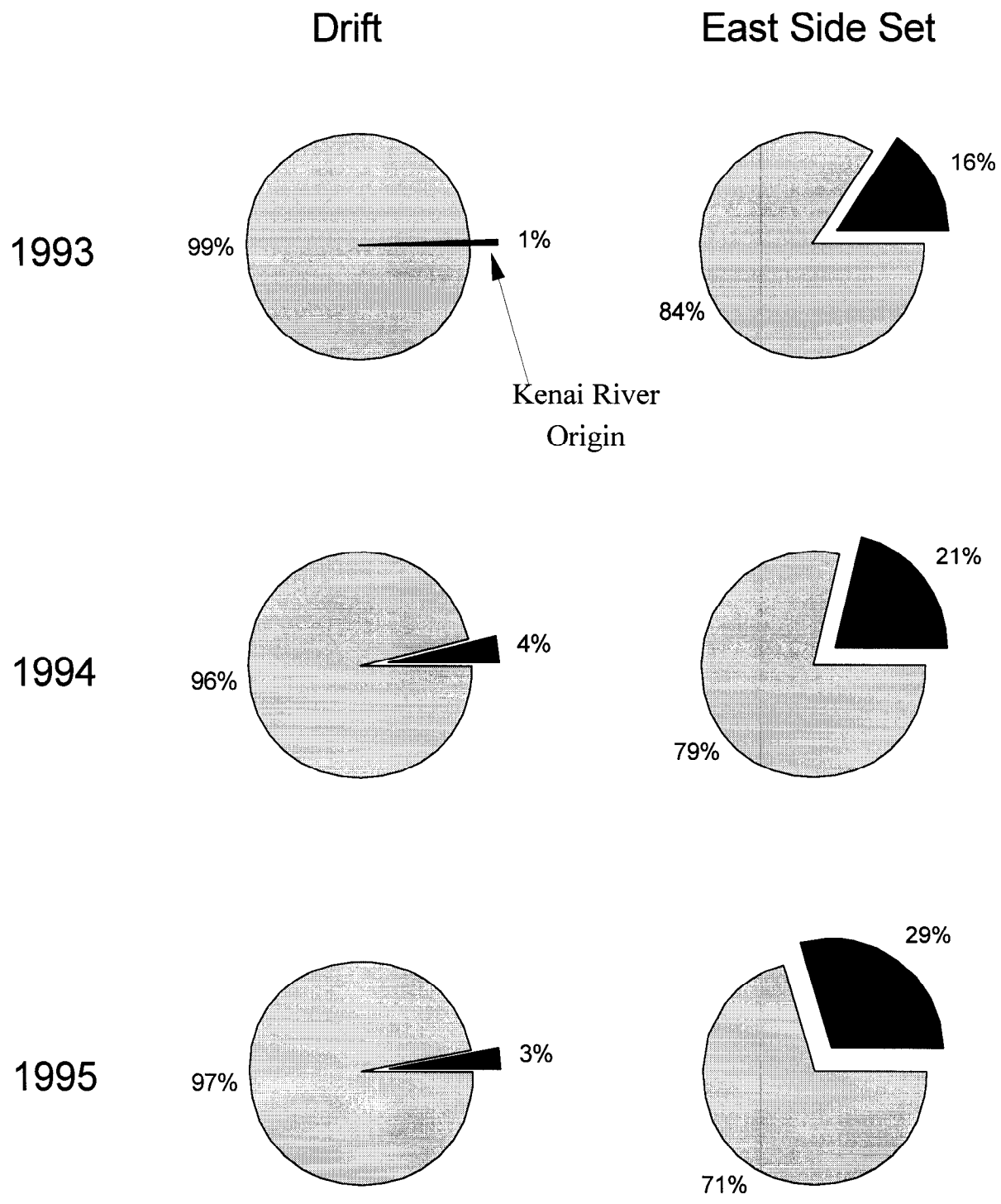



**Figure 14.-Portions of selected commercial harvests that were coho salmon of Kenai River origin in the Central District of Upper Cook Inlet, Alaska, 1993 through 1995.**

## COMMERCIAL FISHERY INFORMATION

Coho salmon of Kenai River origin were present in the drift harvest during much of the fishing season, but contributed the greatest number of fish to the harvest during a 3-week period. Harvest during the last week of July and the first 2 weeks of August accounted for most of the harvest of coho salmon from the Kenai River. Over 60% of the total coho salmon harvest occurring in the drift gillnet fishery occurred before this period. Coded wire tags of Kenai River origin were not recovered from the harvest before mid-July.

A harvest timing pattern was also detected in the eastside set gillnet fishery. Although most of the harvest in this fishery occurred during the last week of July and the first 2 weeks of August, the majority of the harvest of fish from the Kenai River occurred during the first 2 weeks of August; relatively few fish were harvested during the last week of July. The only exception to this general pattern was in the southern-most statistical area, 244-21, where harvest of fish from the Kenai River was greater during the last week of July than during the second week of August.

The timing patterns in both fisheries in 1995 were similar to those in 1993 and 1994 (Carlon and Hasbrouck 1996). Also similar in 1995 was the geographic trend among the four statistical areas of the eastside set gillnet fishery. The increasing trend in total harvest from the southernmost area to the northernmost area was offset by the general decreasing trend in the portion of each area harvest composed of coho salmon from the Kenai River. The result was a similar harvest among statistical areas of coho salmon from the Kenai River.

Daily estimates of the harvests of marked cohorts allowed evaluation of an Upper Cook Inlet drift fishery management practice developed by CFMD staff (Paul Ruesch, Alaska Department of Fish and Game, personal communication). The Upper Cook Inlet Salmon Management Plan directs the department to manage fisheries to achieve sockeye salmon escapement goals in major tributaries to Cook Inlet and to minimize the harvest of coho and chinook *O. tshawytscha* salmon consistent with achieving the sockeye salmon escapement goals. One of the many inseason actions commonly used to achieve these and other management plan goals is to restrict drift gillnet fishing to a zone within 3 miles of most of the eastern shore of the Central District (Figure 15). The drift gillnet fleet is restricted to various portions of this zone, commonly referred to as "the corridor," at selected times to minimize the harvest of salmon stocks migrating farther off shore and to provide fishing opportunity and harvest of stocks migrating near shore.

In 1995, daily harvests of all coho salmon were substantially lower during corridor fishing periods than during district-wide periods (Figure 16). In addition, the estimated harvest of coho salmon from the Kenai River during corridor fishing periods was generally substantially less than during district-wide periods occurring on nearby dates. A minority (about 10%) of the harvest of coho salmon from the Kenai River occurred on days when drift gillnetting was restricted to the corridor. A similar relationship between corridor periods and coho salmon harvests occurred in 1993 (Figure 17) and 1994 (Figure 18). The corridor appears to be an effective tool in reducing the overall harvest of coho salmon without resulting in increased harvest of coho salmon destined for the Kenai River.

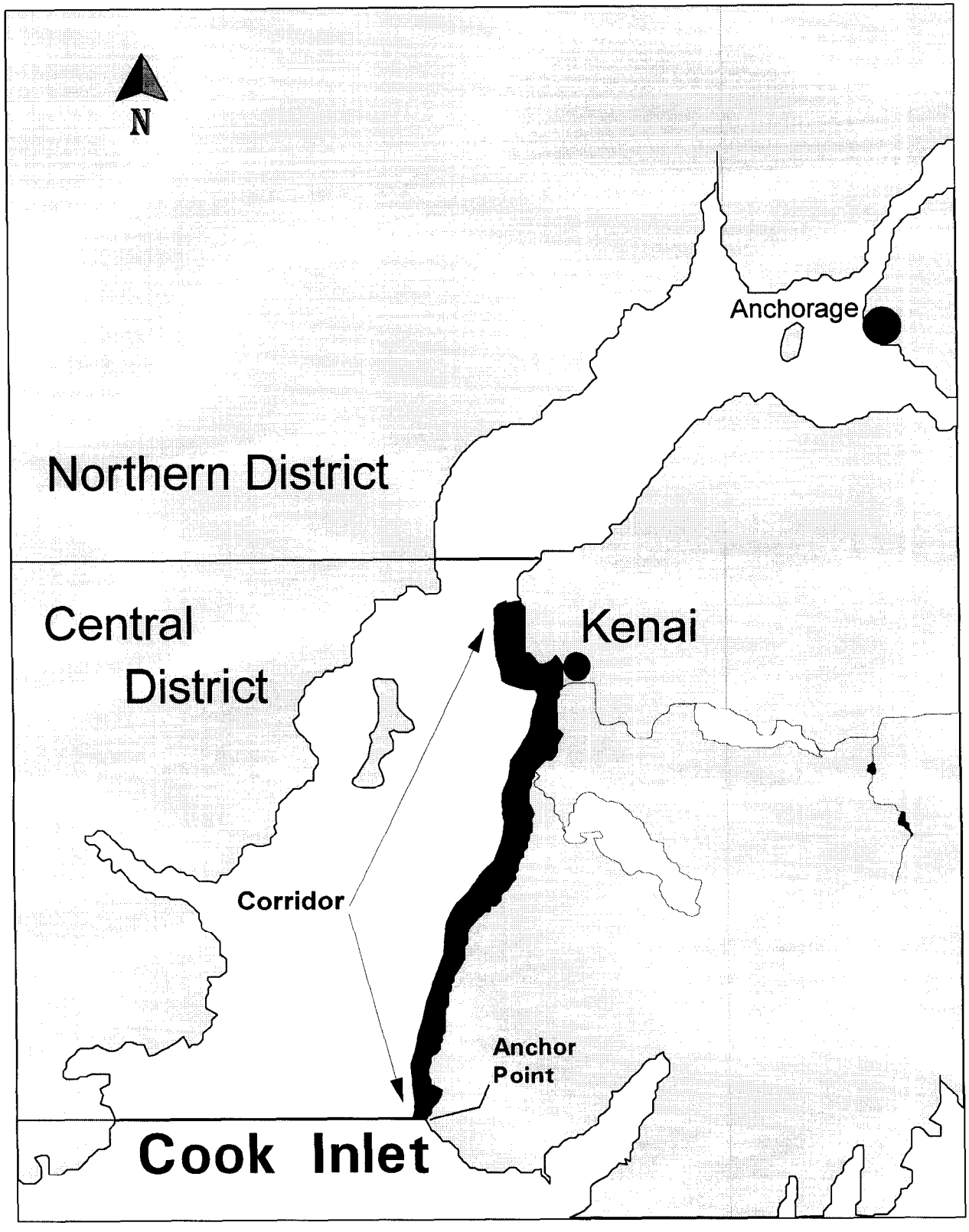



**Figure 15.-Schematic map of the corridor fishing area used in the management of the commercial drift gillnet fishery in the Central District.**

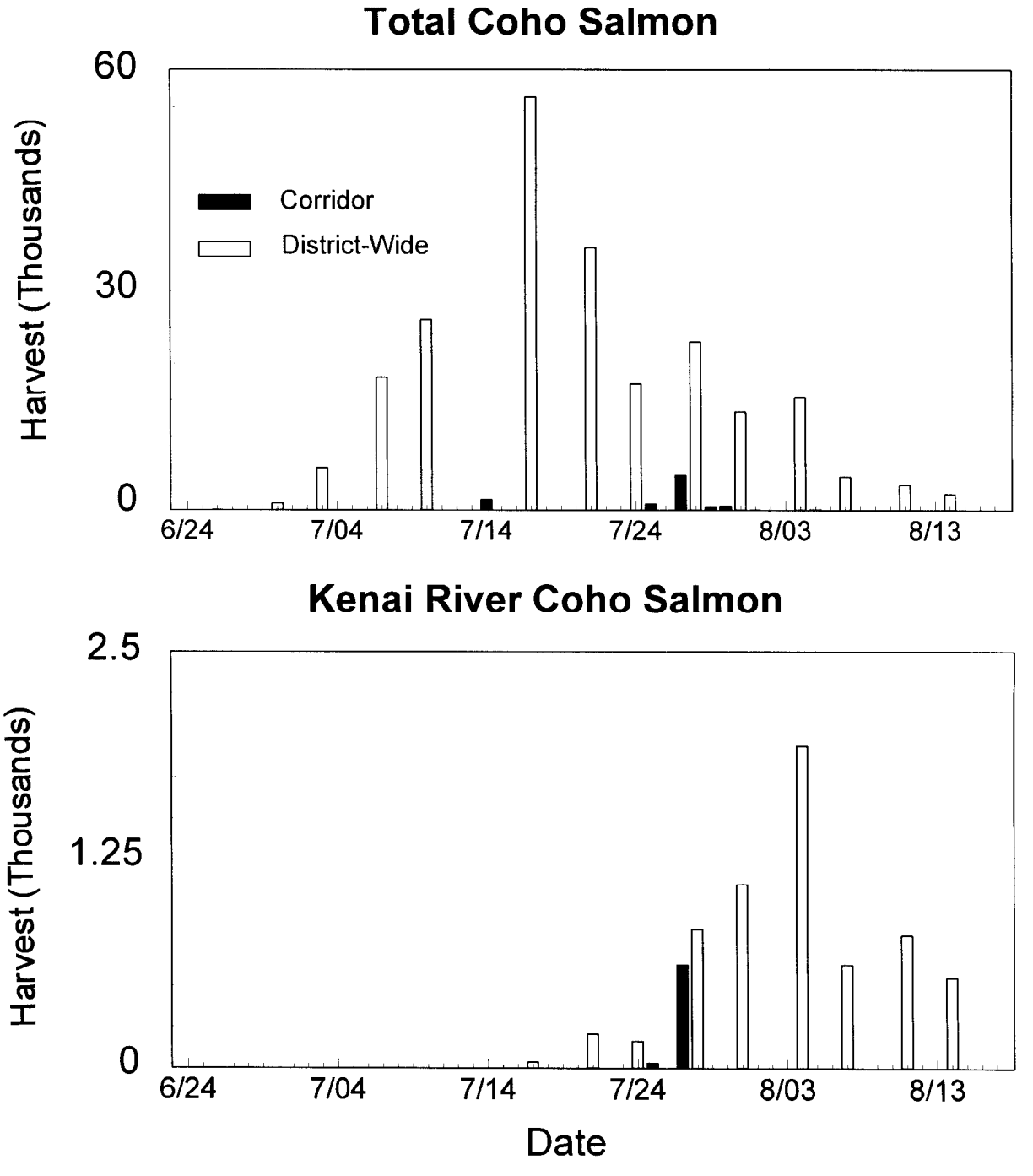



**Figure 16.-Daily harvest of coho salmon and of coho salmon of Kenai River origin in the Central District drift gillnet fishery from June 24 through August 14, 1995.**

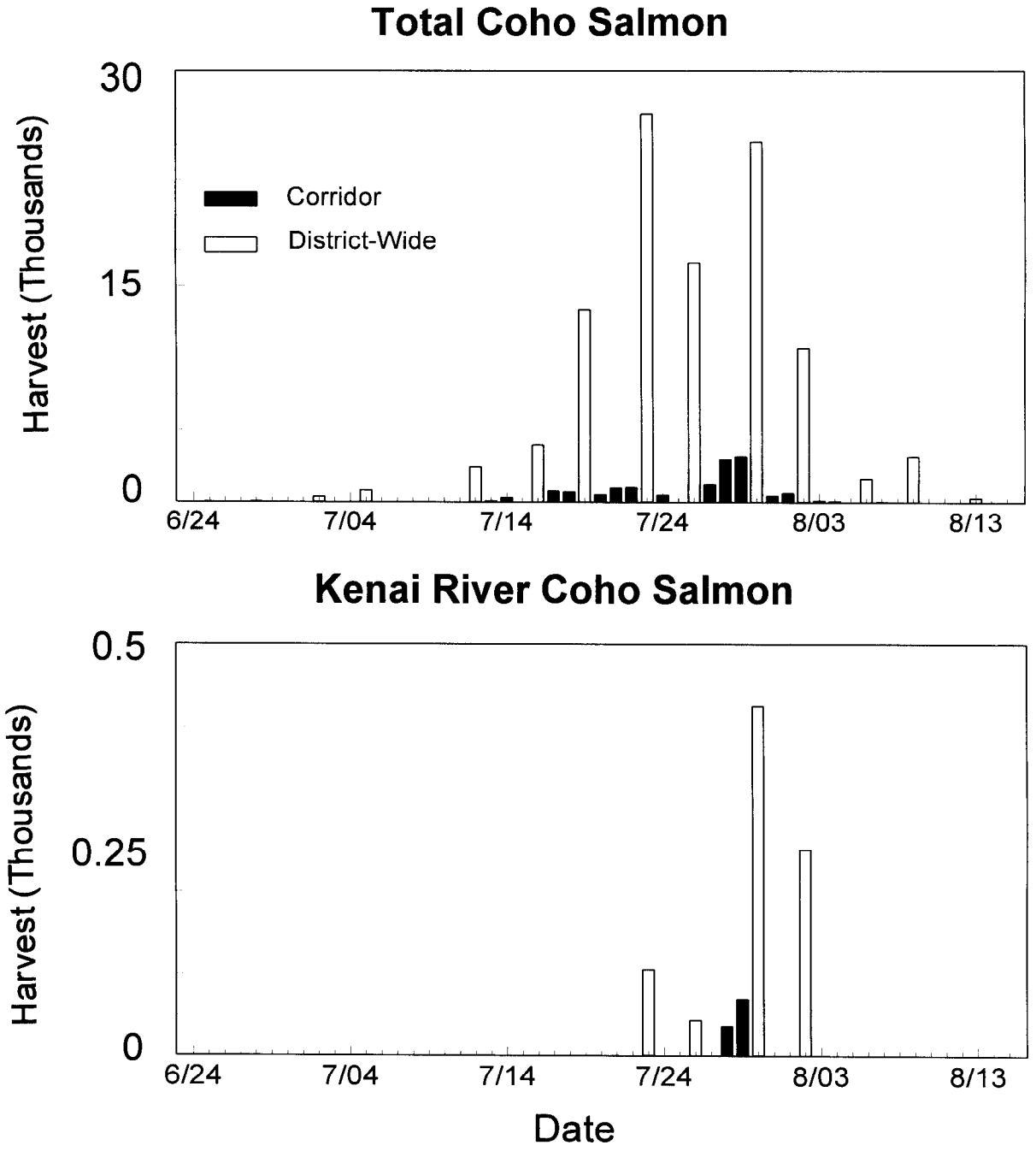



**Figure 17.-Daily harvest of coho salmon and of coho salmon of Kenai River origin in the Central District drift gillnet fishery from June 24 through August 13, 1993.**

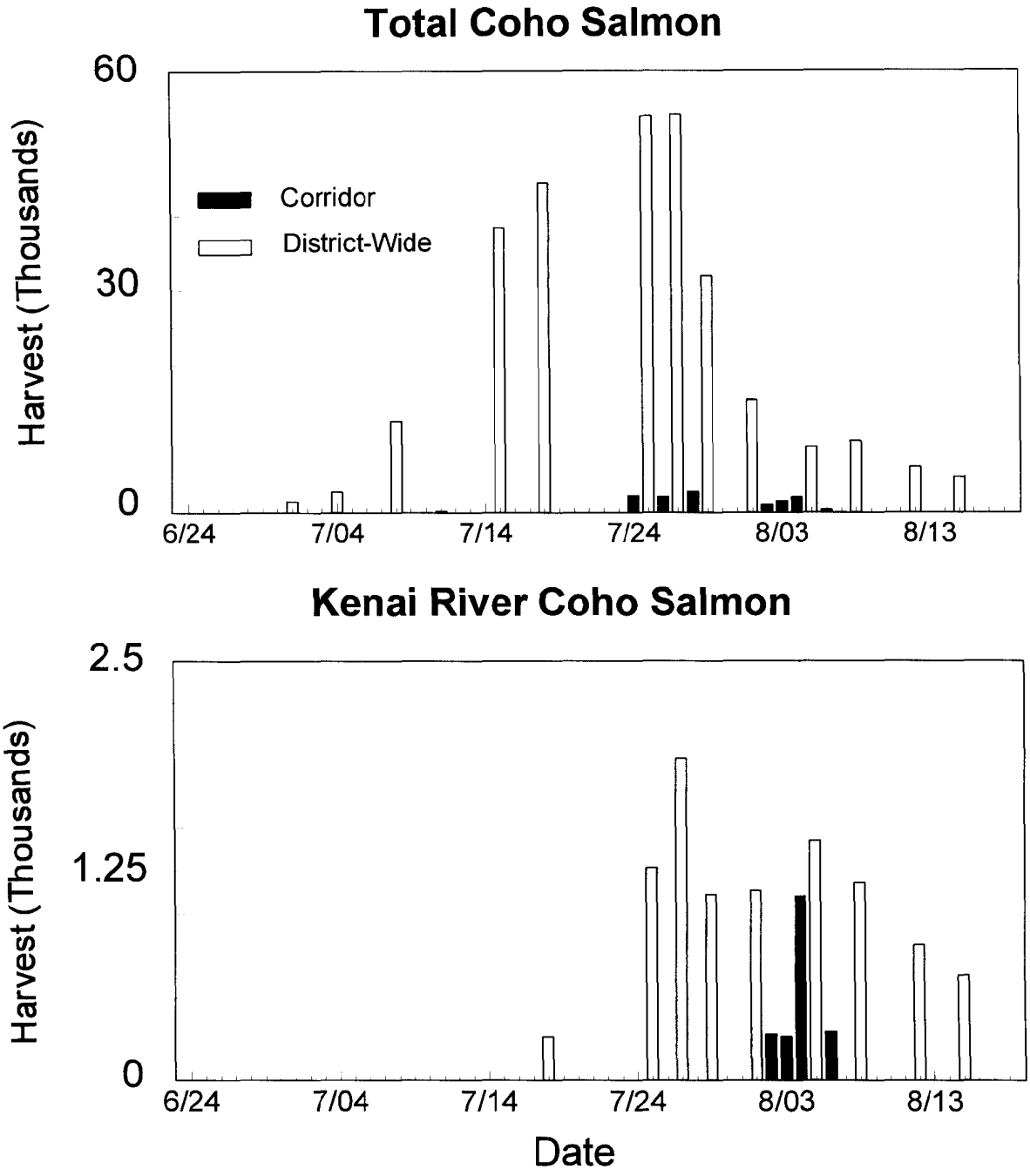



**Figure 18.-Daily harvest of coho salmon and of coho salmon of Kenai River origin in the Central District drift gillnet fishery from June 24 through August 15, 1994.**

## PROJECT DESIGN CONSIDERATIONS

### Juvenile Marking

Based on the return timing of tag recoveries from the inriver sport fishery in previous years, the Moose River was selected as the sole source of smolt for marking in 1994 (Carlon and Hasbrouck 1996). Although there was some bias in the marked sample with respect to return timing, that bias appears to have a minimal affect on the accuracy of commercial harvest estimates. Capturing smolt emigrating from the Moose River therefore was an effective approach for obtaining a sample of Kenai River smolt for the third consecutive year.

Long-term smolt-to-adult tag loss was not an impediment to estimating commercial harvest in 1995. High tag loss rates would require marking more juveniles or that a greater portion of the commercial harvest be examined to maintain desired levels of precision in commercial harvest estimates. Tag loss resulted in a smolt abundance estimate for 1993 that was biased somewhat high (Carlon and Hasbrouck 1996). However, the tag loss rate of 3% observed in the 1995 adult return would introduce insignificant bias. Low smolt-to-adult tag loss rates in Cook Inlet tagging studies have been associated with proper selection of headmold size (Peltz and Hansen 1994).

The estimated variance of smolt abundance is biased somewhat low; abundance estimates appear more precise than they truly are. Because the head was not always collected from an adult coho salmon in the sport harvest that was missing the adipose fin, the number of fish marked at the Moose River that were actually observed in the sport harvest was estimated. Variability due to estimating the number of fish tagged at the Moose River was not included in the variance of abundance. With the large sample sizes from the sport harvest and the preponderance of fish tagged at the Moose River among heads actually collected, the bias in the estimated variance is likely small.

### Harvest Sampling

Estimates of the commercial harvest of coho salmon from the Kenai River were more precise in 1995 than in 1993 and 1994. This occurred primarily because more juveniles were released with coded wire tags in 1994 and subsequently recovered as adults. The level of adult sampling in both the sport and commercial fisheries was similar among years and the major processors were sampled again in 1995. Based on the sample effort from 1993 through 1995, approximately 20%-25% of the drift gillnet harvest and 15%-20% of the eastside set gillnet harvest should be sampled to ensure that estimates in future years have similar levels of precision. This sampling goal was achieved in all 3 years and is based on a marking goal of 95,000 smolt annually (Carlon *Unpublished*). Maintaining this level sampling (when 95,000 smolt are marked) should maintain adequate precision in harvest estimates and minimize potential sources of bias.

The commercial harvest occurring during several days in 1995 was not examined. This is similar to the situation occurring in 1993 and 1994. The schedule of harvest delivery to commercial processors is highly variable due to weather, tide stage, equipment malfunctions, and other factors. Sampling personnel develop sampling routes and schedules based on the best available information; changes in delivery schedules or locations may result in unexamined harvests. Although it is desirable to sample the harvest of every fishing period, this may not be logistically possible with the current level of funding. The model expands harvest estimates to incorporate unsampled days, but assumes this expansion does not introduce significant bias (only 5% of the

drift gillnet harvest and 16% of the eastside set gillnet harvest occurred on dates not sampled in 1995). This level of sampling was considered adequate to attain the desired accuracy and precision of the harvest estimates. The substantial sampling coverage achieved each year is attributable to the experience of CFMD Division personnel managing the sampling program.

The level of inriver sampling achieved from 1993 through 1995 (about 4,500 to 5,500 fish) is also considered adequate. The accuracy and precision of commercial harvest and smolt abundance estimates were within acceptable levels.

## RECOMMENDATIONS

1. If the annual harvest of coho salmon from the Kenai River remains high, conservative management or a more comprehensive research program should be considered.

   Because the stock assessment program is in its infancy, there is a lack of biological perspective to define specific conservation concerns. However, a nine-fold increase in the inriver sport harvest has occurred between 1977 and 1994 and the estimated combined harvest (commercial, sport, and personal use) in 1994 was about 118,000 coho salmon. The increasing trend and the sizable 1994 harvest have led to a general management concern because the escapement remains unknown.

   Management strategies that reduce harvest should therefore be considered or a baseline estimate of exploitation rate (and escapement) should be pursued. An estimate of exploitation rate would provide perspective with which to interpret smolt abundance and harvest estimates provided thus far in this assessment program.

2. Continue estimating commercial harvest of coho salmon of Kenai River origin.

   Commercial harvest estimates are a partial requirement to determine the total annual fishing mortality imposed on this population. The long-term relationship between total annual fishing mortality and smolt production will be monitored to determine if harvest levels are influencing smolt production. Total harvest is also needed to determine the exploitation rate if suitable methods of estimating escapement are developed.

3. Determine if a relationship exists between harvest of coho salmon and timing of fishery area closures in the eastside set gillnet fishery.

   Information provided by this assessment program illustrated the relationship between the harvest of coho salmon from the Kenai River and the drift fishery "corridor" management strategy. Tag recovery data collected since 1993 should be examined for its utility in illustrating the effect of management actions on the drift gillnet and eastside set gillnet harvests.

4. Continue marking coho salmon smolt at the Moose River and continue evaluating the suitability of this strategy for estimating commercial harvest and smolt abundance.

   The Moose River has provided an abundant source of smolt to mark and is the only site to date that has provided a sufficiently representative sample of Kenai River coho salmon with respect to return timing. However, some statistical differences in the marked proportion were detected in 1995 during sport harvest sampling of adults. Annual evaluation of the marked

population for suitability in estimating commercial harvest and smolt abundance should continue. This includes monitoring the marked proportion over the duration of the return for temporal variation of a magnitude that would substantially affect the accuracy of commercial harvest estimates. It also includes evaluating assumptions associated with the model used to estimate smolt abundance.

## ACKNOWLEDGMENTS

The following people assisted with the smolt marking in 1994. Jerry Strait provided training for project staff in the use of coded wire tagging equipment and also provided field supervision at the Moose River weir. Earl Chauvin, Wendy Langston, Jan Rumble, Kurt Strausbaugh, and Troy Tydingco marked smolt and provided logistical support. Soldotna Sport Fish staff provided additional logistical support.

The commercial harvest was examined by technicians of the Commercial Fisheries Management and Development Division. Dave Waltemyer and Kim Rudge supervised commercial harvest sampling, provided logistical support, and collated commercial sampling data. Ed Borden, Phyllis McCutchan, and Gary Titus sampled the sport harvest. Sandee Simons also assisted with sport harvest sampling. Mary Schwager-King provided logistical support. Terry Bendock and Steve Hammarstrom provided guidance, insight, and logistical support throughout the project. Scott Meyer, Doug Vincent-Lang, and Doug McBride provided the vision to initiate the project.

Jim and Jane Fellman and family granted convenient access to the Moose River through their property. Dr. Bill West granted access to a convenient boat launch on the Moose River.

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# APPENDIX A

**Appendix A1.-Number of wild coho salmon smolt captured from the Moose River, marked with coded wire tags, and released in 1994.**

| Tag Code | First Day Released | Last Day Released | Number of Smolt Marked[a] | Short-Term Survival Rate | Est. Number of Marked Smolt Released[b] | Short-Term Tag Retention Rate | Estimated Number of Tagged Smolt Released[c] |
|---|---|---|---|---|---|---|---|
| 31-22-19 | 5/20 | 5/27 | 6,262 | 100.0% | 6,262 | 100.0% | 6,262 |
| 31-22-27 | 5/26 | 5/28 | 6,167 | 100.0% | 6,167 | 99.5% | 6,136 |
| 31-22-28 | 5/27 | 5/29 | 6,470 | 100.0% | 6,470 | 98.3% | 6,360 |
| 31-22-29 | 5/28 | 5/30 | 5,976 | 99.6% | 5,950 | 100.0% | 5,950 |
| 31-22-40 | 5/29 | 5/31 | 6,025 | 100.0% | 6,025 | 99.4% | 5,989 |
| 31-22-41 | 5/30 | 6/01 | 6,085 | 100.0% | 6,085 | 99.5% | 6,055 |
| 31-22-42 | 5/31 | 6/02 | 6,107 | 100.0% | 6,107 | 100.0% | 6,107 |
| 31-23-21 | 6/01 | 6/03 | 11,702 | 99.9% | 11,688 | 99.6% | 11,641 |
| 31-23-22 | 6/02 | 6/04 | 11,582 | 100.0% | 11,578 | 99.4% | 11,509 |
| 31-23-23 | 6/03 | 6/06 | 11,594 | 100.0% | 11,594 | 99.7% | 11,559 |
| 31-23-24 | 6/05 | 6/07 | 11,671 | 100.0% | 11,671 | 98.1% | 11,449 |
| 31-23-25 | 6/06 | 6/08 | 11,921 | 100.0% | 11,921 | 97.7% | 11,647 |
| 31-24-03 | 6/07 | 6/09 | 11,867 | 100.0% | 11,775 | 100.0% | 11,775 |
| 31-24-04 | 6/08 | 6/11 | 12,064 | 100.0% | 11,992 | 99.8% | 11,968 |
| 31-24-05 | 6/10 | 6/12 | 12,175 | 100.0% | 12,135 | 99.6% | 12,086 |
| 31-24-06 | 6/11 | 6/13 | 11,716 | 100.0% | 11,716 | 96.7% | 11,329 |
| 31-24-07 | 6/12 | 6/17 | 11,982 | 100.0% | 11,982 | 99.0% | 11,862 |
| 31-22-43 | 6/16 | 6/18 | 6,093 | 100.0% | 6,093 | 98.9% | 6,026 |
| 31-22-32 | 6/17 | 6/21 | 4,352 | 100.0% | 4,352 | 99.9% | 4,348 |
| Total | | | 171,811 | | 171,563 | | 170,058 |

[a] Total number of smolt adipose-clipped and injected with a coded wire tag.

[b] Estimated number of marked smolt that survived after release.

[c] Estimated number of marked smolt that survived and retained a tag after release.

**Appendix A2.-Sources of marked coho salmon adults recovered from the Kenai River sport harvest during August and September 1995 as determined from recovery of coded wire tags.**

| Date | Number Examined | Marked Fish Observed | Marked Fish Recovered | CWT Missing | Release Location and Year of Release: Moose River 1994 | Moose River 1995 | Ship Creek [a] 1994 |
|---|---|---|---|---|---|---|---|
| RANDOM SAMPLES | | | | | | | |
| 08/02 | 5 | 1 | 1 | 0 | 1 | 0 | 0 |
| 08/03 | 20 | 7 | 6 | 0 | 6 | 0 | 0 |
| 08/04 | 51 | 15 | 9 | 0 | 9 | 0 | 0 |
| 08/05 | 53 | 12 | 11 | 0 | 11 | 0 | 0 |
| 08/06 | 46 | 6 | 5 | 0 | 5 | 0 | 0 |
| 08/07 | 124 | 33 | 18 | 0 | 18 | 0 | 0 |
| 08/08 | 69 | 22 | 18 | 0 | 18 | 0 | 0 |
| 08/09 | 55 | 17 | 13 | 0 | 13 | 0 | 0 |
| 08/10 | 44 | 12 | 6 | 0 | 6 | 0 | 0 |
| 08/11 | 111 | 21 | 13 | 0 | 13 | 0 | 0 |
| 08/12 | 69 | 29 | 4 | 0 | 4 | 0 | 0 |
| 08/13 | 74 | 20 | 16 | 1 | 15 | 0 | 0 |
| 08/14 | 171 | 40 | 23 | 0 | 23 | 0 | 0 |
| 08/15 | 174 | 36 | 27 | 1 | 25 | 0 | 1 |
| 08/16 | 194 | 34 | 20 | 1 | 19 | 0 | 0 |
| 08/17 | 127 | 30 | 29 | 0 | 29 | 0 | 0 |
| 08/18 | 209 | 31 | 29 | 0 | 29 | 0 | 0 |
| 08/19 | 192 | 41 | 31 | 4 | 27 | 0 | 0 |
| 08/20 | 158 | 28 | 21 | 0 | 21 | 0 | 0 |
| 08/21 | 98 | 20 | 17 | 1 | 16 | 0 | 0 |
| 08/22 | 129 | 31 | 29 | 4 | 25 | 0 | 0 |
| 08/23 | 140 | 47 | 38 | 3 | 34 | 1 | 0 |
| 08/24 | 51 | 4 | 2 | 0 | 2 | 0 | 0 |
| 08/25 | 33 | 12 | 8 | 0 | 8 | 0 | 0 |
| 08/26 | 63 | 22 | 18 | 0 | 18 | 0 | 0 |
| 08/27 [b] | 118 | 37 | 26 | 0 | 25 | 0 | 0 |
| 08/28 | 84 | 24 | 21 | 0 | 21 | 0 | 0 |
| 08/29 | 106 | 29 | 20 | 1 | 18 | 0 | 1 |
| 08/30 | 110 | 30 | 25 | 1 | 24 | 0 | 0 |
| 08/31 | 78 | 19 | 15 | 0 | 15 | 0 | 0 |
| Aug Total | 2,956 | 710 | 519 | 17 | 498 | 1 | 2 |

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## Appendix A2.-Page 2 of 2.

| Date | Number Examined | Marked Fish Observed | Marked Fish Recovered | CWT Missing | Release Location and Year of Release: Moose River 1994 | Moose River 1995 | Ship Creek [a] 1994 |
|---|---|---|---|---|---|---|---|
| 09/01 | 72 | 24 | 16 | 0 | 15 | 1 | 0 |
| 09/02 | 81 | 36 | 24 | 0 | 24 | 0 | 0 |
| 09/03 | 55 | 22 | 17 | 0 | 17 | 0 | 0 |
| 09/04 | 184 | 73 | 59 | 1 | 57 | 1 | 0 |
| 09/05 | 122 | 29 | 22 | 0 | 22 | 0 | 0 |
| 09/06 | 63 | 23 | 13 | 0 | 13 | 0 | 0 |
| 09/07 | 69 | 19 | 18 | 0 | 18 | 0 | 0 |
| 09/08 | 86 | 32 | 25 | 1 | 24 | 0 | 0 |
| 09/09 | 188 | 64 | 38 | 1 | 37 | 0 | 0 |
| 09/10 | 125 | 39 | 31 | 1 | 30 | 0 | 0 |
| 09/11 | 127 | 48 | 33 | 1 | 32 | 0 | 0 |
| 09/12 | 172 | 50 | 40 | 2 | 38 | 0 | 0 |
| 09/13 | 189 | 70 | 59 | 2 | 57 | 0 | 0 |
| 09/14 | 18 | 10 | 6 | 0 | 6 | 0 | 0 |
| 09/15 | 0 | | | | | | |
| 09/16 | 56 | 25 | 18 | 2 | 16 | 0 | 0 |
| 09/17 | 75 | 20 | 12 | 0 | 12 | 0 | 0 |
| 09/18 | 60 | 14 | 11 | 0 | 11 | 0 | 0 |
| 09/19 | 65 | 17 | 14 | 0 | 14 | 0 | 0 |
| 09/20 | 56 | 22 | 18 | 1 | 17 | 0 | 0 |
| 09/21 [c] | 0 | | | | | | |
| 09/22 [c] | 0 | | | | | | |
| 09/23 [c] | 0 | | | | | | |
| 09/24 [c] | 0 | | | | | | |
| 09/25 [c] | 0 | | | | | | |
| 09/26 [c] | 0 | | | | | | |
| 09/27 [c] | 0 | | | | | | |
| 09/28 | 6 | 2 | 1 | 0 | 1 | 0 | 0 |
| 09/29 | 11 | 4 | 2 | 0 | 2 | 0 | 0 |
| 09/30 | 2 | 2 | 2 | 0 | 2 | 0 | 0 |
| Sept Total | 1,882 | 645 | 479 | 12 | 465 | 2 | 0 |
| Random Total | 4,838 | 1,355 | 998 | 29 | 963 | 3 | 2 |
| Non-Random Samples [d] | | | | | | | |
| 08/09 | | | 6 | | 6 | | |
| 08/10 | | | 2 | | 2 | | |
| 08/11 | | | 2 | | 2 | | |
| 08/13 | | | 5 | 1 | 4 | | |
| 08/19 | | | 1 | | 1 | | |
| 08/31 | | | 1 | 1 | | | |
| 09/20 | | | 9 | | 9 | | |
| Aug/Sept Total | | | 26 | 2 | 24 | 0 | 0 |

[a] Two hatchery-produced coho salmon that were released as smolt in Cook Inlet at locations other than the Kenai River were captured in the Kenai River.

[b] One recovered tag was not readable.

[c] A 147-year flood precluded anglers from fishing during the period 09/21 through 09/27. No fish were examined during this period.

[d] Non-random recoveries are voluntary angler returns to ADF&G personnel and are not used in quantitative calculations.

**Appendix A3.-Kenai River recreational harvest recoveries in 1995 of coho salmon adults marked as smolt early (May 20-June 6) in the 1994 emigration from the Moose River.**

| Date of | Coded Wire Tag Codes [a] and Last Date of Release in 1994 for Each Code - Early Smolt[b] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adult | 22-19 | 22-27 | 22-28 | 22-29 | 22-40 | 22-41 | 22-42 | 23-21 | 23-22 | 23-23 | 23-24 | Early |
| Recovery[c] | 05/26 | 05/27 | 05/28 | 05/29 | 05/30 | 05/31 | 06/01 | 06/02 | 06/03 | 06/05 | 06/06 | Total |
| 08/01 | | | | | | | | | | | | |
| 08/02 | | | | | | | | | 1 | | | 1 |
| 08/03 | | | | | | | | 3 | 1 | | | 4 |
| 08/04 | | | | 1 | 1 | | | | | 1 | | 3 |
| 08/05 | 1 | 1 | 1 | | | | 1 | | | 1 | | 5 |
| 08/06 | 1 | | | | | | | | | | | 1 |
| 08/07 | 1 | 1 | | 1 | 1 | | 1 | 3 | 2 | 2 | | 12 |
| 08/08 | | 1 | | 1 | | 2 | | 2 | 2 | 1 | | 9 |
| 08/09 | | 2 | 1 | 2 | 1 | | | | | | 1 | 7 |
| 08/10 | | | | | | 1 | | 2 | 1 | 1 | | 5 |
| 08/11 | | | | | | | 2 | 1 | 2 | 3 | | 8 |
| 08/12 | | | | | | | | | 2 | | | 2 |
| 08/13 | 1 | 1 | | | 2 | | | | | 2 | 1 | 7 |
| 08/14 | 3 | 2 | | | 1 | | 1 | 2 | 1 | 1 | 1 | 12 |
| 08/15 | 1 | 1 | 1 | 1 | | | 1 | 4 | 1 | 3 | | 13 |
| Period Total | 8 | 9 | 3 | 6 | 6 | 3 | 6 | 17 | 13 | 15 | 3 | 89 |
| 08/16 | | 3 | 1 | | 1 | 1 | | 1 | 1 | 2 | | 10 |
| 08/17 | 2 | | 2 | 1 | | | 1 | 3 | 3 | 1 | 1 | 14 |
| 08/18 | 1 | 2 | 1 | | 2 | 2 | 1 | 2 | 2 | 1 | 4 | 18 |
| 08/19 | | | | 3 | 1 | | | 3 | 1 | 1 | 1 | 10 |
| 08/20 | 2 | 1 | 2 | 3 | | | | 1 | 1 | 3 | | 13 |
| 08/21 | 1 | 2 | 2 | 1 | 1 | 1 | | | | 2 | | 10 |
| 08/22 | 3 | 1 | 2 | 1 | | 3 | 1 | 2 | 2 | 2 | | 17 |
| 08/23 | 1 | 2 | 1 | 2 | 2 | 2 | 1 | 3 | 3 | 2 | 2 | 21 |
| 08/24 | | | | | | | | | 1 | | | 1 |
| 08/25 | | | | | | 1 | | | | | | 1 |
| 08/26 | 1 | 3 | | 2 | 3 | | 1 | 1 | 3 | | | 14 |
| 08/27 | 2 | 1 | 3 | 2 | 2 | | | 1 | 1 | 2 | | 14 |
| 08/28 | | 2 | | 3 | 1 | | 1 | 1 | 1 | 2 | 2 | 13 |
| 08/29 | 1 | | 1 | 3 | 1 | 1 | | 1 | 3 | | | 11 |
| 08/30 | 2 | 1 | | 2 | 2 | | 1 | 5 | | 2 | 1 | 16 |
| 08/31 | 2 | 1 | 1 | 1 | 1 | 1 | | | 2 | 1 | 1 | 11 |
| Period Total | 18 | 19 | 16 | 24 | 17 | 12 | 7 | 24 | 24 | 21 | 12 | 194 |

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**Appendix A3.-Page 2 of 2.**

| Date of Adult Recovery[c] | Coded Wire Tag Codes [a] and Last Date of Release in 1994 for Each Code - Early Smolt[b] | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 22-19 05/26 | 22-27 05/27 | 22-28 05/28 | 22-29 05/29 | 22-40 05/30 | 22-41 05/31 | 22-42 06/01 | 23-21 06/02 | 23-22 06/03 | 23-23 06/05 | 23-24 06/06 | Early Total |
| 09/01 | | 1 | | 1 | | | | 3 | 2 | 1 | 2 | 10 |
| 09/02 | | 3 | 1 | 1 | 4 | | 1 | 5 | | | | 15 |
| 09/03 | | 1 | 1 | | | | 1 | 2 | 1 | 1 | 1 | 8 |
| 09/04 | 3 | 1 | 3 | 2 | 6 | 6 | 2 | 7 | 5 | 1 | 1 | 37 |
| 09/05 | 2 | 1 | | 2 | | | 3 | 1 | | | 1 | 10 |
| 09/06 | | 1 | 1 | 2 | 1 | | | 1 | 1 | 1 | 1 | 9 |
| 09/07 | 1 | | 1 | 1 | | | | | | 3 | 1 | 7 |
| 09/08 | | 2 | 1 | | 2 | | 2 | 2 | 1 | 2 | 3 | 15 |
| 09/09 | 1 | 1 | 2 | 1 | 3 | 2 | 1 | 5 | 3 | 2 | 1 | 22 |
| 09/10 | | 2 | 1 | 4 | | 2 | 1 | 1 | 1 | 1 | 2 | 15 |
| 09/11 | 1 | | 3 | | 1 | 2 | 1 | 3 | 3 | 1 | 3 | 18 |
| 09/12 | 1 | 2 | 2 | | | 3 | | 2 | 4 | 1 | | 15 |
| 09/13 | 4 | 2 | 1 | | 3 | 2 | 1 | 8 | 5 | 5 | 3 | 34 |
| 09/14 | | | | | | | | 1 | | | | 1 |
| 09/15 | | | | | | | | | | | | |
| Period Total | 13 | 17 | 17 | 14 | 20 | 17 | 13 | 41 | 26 | 19 | 19 | 216 |
| 09/16 | | | | 1 | 1 | | 1 | | 4 | 1 | 1 | 9 |
| 09/17 | | | | | | | | 1 | | 1 | 3 | 5 |
| 09/18 | 1 | 1 | | | | | | 2 | | 1 | | 5 |
| 09/19 | 1 | | | 1 | | | 1 | | 1 | 2 | | 6 |
| 09/20 | | | 1 | | 1 | | | 2 | 2 | 3 | | 9 |
| 09/21 | | | | | | | | | | | | |
| 09/22 | | | | | | | | | | | | |
| 09/23 | | | | | | | | | | | | |
| 09/24 | | | | | | | | | | | | |
| 09/25 | | | | | | | | | | | | |
| 09/26 | | | | | | | | | | | | |
| 09/27 | | | | | | | | | | | | |
| 09/28 | | | | | | | | | | | | |
| 09/29 | 1 | | | | | 1 | | | | | | 2 |
| 09/30 | | | | | | | 1 | | | | | 1 |
| Period Total | 3 | 1 | 1 | 2 | 2 | 1 | 3 | 5 | | 8 | 4 | 37 |
| Season Total | 42 | 46 | 37 | 46 | 45 | 33 | 29 | 87 | | 63 | 38 | 536 |

[a] The agency code for all tags released is 31.

[b] The term "Early Smolt" refers to the first 50% of the smolt tagged.

[c] A 147-year flood event precluded anglers from fishing during the period 09/21 through 09/27 when no fish were examined.

**Appendix A4.-Kenai River recreational harvest recoveries in 1995 of coho salmon adults marked as smolt late (June 7-June 20) in the 1994 emigration from the Moose River.**

| Date of Adult Recovery[c] | Coded Wire Tag Codes[a] and Last Date of Release in 1994 for Each Code - Late Smolt[b] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 23-25 06/07 | 24-03 06/08 | 24-04 06/10 | 24-05 06/11 | 24-06 06/12 | 24-07 06/16 | 22-43 06/17 | 22-32 06/20 | Late Total |
| 08/01 | | | | | | | | | |
| 08/02 | | | | | | | | | |
| 08/03 | | 2 | | | | | | | 2 |
| 08/04 | | 2 | 1 | | | 2 | 1 | | 6 |
| 08/05 | 1 | | 1 | 1 | 1 | 1 | | 1 | 6 |
| 08/06 | 1 | | 1 | | | 1 | | 1 | 4 |
| 08/07 | 1 | 1 | 1 | | | 2 | | 1 | 6 |
| 08/08 | | 1 | 1 | 1 | 3 | 2 | 1 | | 9 |
| 08/09 | 2 | 1 | 2 | 1 | | | | | 6 |
| 08/10 | 1 | | | | | | | | 1 |
| 08/11 | | 1 | 1 | 1 | 1 | | | 1 | 5 |
| 08/12 | | | | | 1 | 1 | | | 2 |
| 08/13 | 3 | 1 | 1 | 1 | 1 | | | 1 | 8 |
| 08/14 | 1 | 3 | | 1 | | 1 | 4 | 1 | 11 |
| 08/15 | 3 | 1 | 1 | 1 | 3 | 1 | 1 | 1 | 12 |
| Period Total | 13 | 13 | 10 | 7 | 10 | 11 | 7 | 7 | 78 |
| 08/16 | | 1 | 4 | 2 | 1 | 1 | | | 9 |
| 08/17 | 5 | 2 | 1 | 2 | 1 | 2 | 1 | 1 | 15 |
| 08/18 | 2 | 4 | 1 | 1 | | 1 | 1 | 1 | 11 |
| 08/19 | 4 | 4 | 3 | 2 | 1 | 2 | | 1 | 17 |
| 08/20 | 2 | 1 | 3 | | 1 | 1 | | | 8 |
| 08/21 | 1 | 1 | | | 3 | | | 1 | 6 |
| 08/22 | 2 | | 1 | | 2 | 1 | 2 | | 8 |
| 08/23 | 4 | 1 | 3 | 2 | 1 | 2 | | | 13 |
| 08/24 | 1 | | | | | | | | 1 |
| 08/25 | 1 | | 2 | | 2 | | 1 | 1 | 7 |
| 08/26 | | | | | 2 | 2 | | | 4 |
| 08/27 | 2 | 2 | 2 | | 3 | | 1 | 1 | 11 |
| 08/28 | | 1 | 1 | 2 | 1 | 3 | | | 8 |
| 08/29 | | 2 | 1 | | 1 | 2 | 1 | | 7 |
| 08/30 | 1 | 1 | 1 | | | 3 | 2 | | 8 |
| 08/31 | 1 | 2 | | | | | | 1 | 4 |
| Period Total | 26 | 22 | 23 | 11 | 19 | 20 | 9 | 7 | 137 |

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**Appendix A4.-Page 2 of 2.**

| Date of Adult Recovery[c] | Coded Wire Tag Codes[a] and Last Date of Release in 1994 for Each Code - Late Smolt[b] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 23-25 06/07 | 24-03 06/08 | 24-04 06/10 | 24-05 06/11 | 24-06 06/12 | 24-07 06/16 | 22-43 06/17 | 22-32 06/20 | Late Total |
| 09/01 | 3 | | 2 | | | | | | 5 |
| 09/02 | 2 | 1 | 3 | 1 | 1 | | 1 | | 9 |
| 09/03 | 2 | 2 | | | | 3 | 1 | 1 | 9 |
| 09/04 | 3 | 3 | 4 | 2 | 3 | 2 | 2 | 1 | 20 |
| 09/05 | | 1 | 3 | 3 | 1 | 2 | 2 | | 12 |
| 09/06 | 1 | | 1 | | | 1 | 1 | | 4 |
| 09/07 | | 5 | 2 | | 1 | | 3 | | 11 |
| 09/08 | 1 | 4 | 2 | | | | 1 | 1 | 9 |
| 09/09 | 1 | 3 | 4 | | 3 | | 4 | | 15 |
| 09/10 | 2 | 5 | 2 | | 2 | 2 | 2 | | 15 |
| 09/11 | 1 | 4 | 2 | 2 | 1 | 3 | | 1 | 14 |
| 09/12 | 5 | 4 | | 2 | 7 | 4 | 1 | | 23 |
| 09/13 | 2 | 4 | 1 | 8 | 3 | 3 | | 2 | 23 |
| 09/14 | 1 | | 1 | 2 | | | 1 | | 5 |
| 09/15 | | | | | | | | | |
| Period Total | 24 | 36 | 27 | 20 | 22 | 20 | 19 | 6 | 174 |
| 09/16 | 2 | 1 | | 1 | 1 | 1 | 1 | | 7 |
| 09/17 | | 2 | 1 | | 1 | 3 | | | 7 |
| 09/18 | | 2 | | | 3 | 1 | | | 6 |
| 09/19 | 1 | 2 | 1 | | 1 | 2 | 1 | | 8 |
| 09/20 | 2 | 2 | 3 | | | 1 | | | 8 |
| 09/21 | | | | | | | | | |
| 09/22 | | | | | | | | | |
| 09/23 | | | | | | | | | |
| 09/24 | | | | | | | | | |
| 09/25 | | | | | | | | | |
| 09/26 | | | | | | | | | |
| 09/27 | | | | | | | | | |
| 09/28 | | 1 | | | | | | | 1 |
| 09/29 | | | | | | | | | |
| 09/30 | | | 1 | | | | | | 1 |
| Period Total | 5 | 10 | 6 | 1 | 6 | 8 | 2 | | 38 |
| Season Total | 68 | 81 | 66 | 39 | 57 | 59 | 37 | 20 | 427 |

[a] The agency code for all tags released is 31.

[b] The term "Late Smolt" refers to the second 50% of the smolt tagged.

[c] A 147-year flood event precluded anglers from fishing during the period 09/21 through 09/27 when no fish were examined.

**Appendix A5.-Upper Cook Inlet commercial coho salmon harvest in 1995, coded wire tag recovery, and harvest estimates based on coho salmon marked at the Moose River in 1994.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **CENTRAL DISTRICT** | | | | | | | | | | | |
| Central Drift 244 | | | | | | | | | | | |
| 6/26-7/07 | 24,901 | 4,757 | 44 | 44 | 35 | 35 | 0 | 0 | 0 | | |
| 7/10 | 26,112 | 7,245 | 92 | 92 | 79 | 79 | 0 | 0 | 0 | | |
| 7/14 | 1,523 | 522 | 15 | 15 | 14 | 14 | 0 | 0 | 0 | | |
| 7/17 | 56,387 | 11,117 | 195 | 195 | 171 | 170 | 2 | 38 | 677 | | |
| 7/21 | 36,032 | 8,348 | 257 | 257 | 235 | 234 | 13 | 209 | 3,177 | | |
| 7/24 | 17,287 | 6,203 | 204 | 204 | 188 | 188 | 16 | 165 | 1,562 | | |
| 7/25 | 839 | 183 | 4 | 4 | 4 | 4 | 2 | 34 | 543 | | |
| 7/27 | 4,799 | 622 | 46 | 46 | 43 | 43 | 22 | 629 | 17,659 | | |
| 7/28 | 23,446 | 6,452 | 363 | 360 | 331 | 331 | 62 | 841 | 11,174 | | |
| 7/31 | 14,085 | 3,918 | 332 | 307 | 289 | 289 | 77 | 1,109 | 15,895 | | |
| 8/04-8/05 | 15,462 | 2,910 | 257 | 257 | 243 | 243 | 99 | 1,948 | 39,610 | 1 | |
| 8/07 | 4,558 | 1,666 | 122 | 122 | 110 | 110 | 62 | 628 | 6,071 | | |
| 8/11 | 3,493 | 559 | 55 | 55 | 51 | 50 | 34 | 803 | 18,680 | | |
| 8/14 | 2,256 | 801 | 104 | 104 | 96 | 96 | 53 | 553 | 5,471 | | |
| 8/18-9/01 | 2,946 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| Total | 234,126 | 55,303 | 2,090 | 2,062 | 1,889 | 1,886 | 442 | 6,956 | 120,519 | 1 | 0 |

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**Appendix A5.-Page 2 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| East Side Setnet 244-21 | | | | | | | | | | | |
| 7/03-7/17 | 236 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 7/18-7/19 | 110 | 5 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 7/20-7/21 | 207 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 7/24 | 763 | 249 | 1 | 1 | 1 | 1 | 1 | 11 | 117 | | |
| 7/25 | 261 | 145 | 8 | 8 | 8 | 8 | 5 | 33 | 190 | | |
| 7/27 | 605 | 129 | 12 | 12 | 12 | 12 | 11 | 191 | 3,156 | | |
| 7/28-7/29 | 734 | 138 | 17 | 17 | 16 | 16 | 16 | 315 | 5,974 | | |
| 7/30-7/31 | 506 | 183 | 41 | 40 | 37 | 37 | 37 | 388 | 3,814 | | |
| 8/01 | 335 | 84 | 8 | 8 | 8 | 8 | 8 | 118 | 1,638 | | |
| 8/04-8/05 | 887 | 140 | 24 | 24 | 23 | 23 | 23 | 540 | 12,364 | | |
| 8/07 | 307 | 126 | 6 | 6 | 6 | 6 | 6 | 54 | 437 | | |
| 8/11 | 461 | 214 | 42 | 42 | 39 | 39 | 38 | 303 | 2,193 | | |
| 8/14 | 964 | 190 | 7 | 7 | 7 | 7 | 6 | 113 | 2,015 | | |
| Total | 6,376 | 1,654 | 166 | 165 | 157 | 157 | 151 | 2,067 | 31,898 | 0 | 0 |

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**Appendix A5.-Page 3 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| East Side Setnet 244-22 | | | | | | | | | | | |
| 7/03-7/14 | 356 | 56 | 2 | 2 | 2 | 2 | 0 | 0 | 0 | | |
| 7/17 | 334 | 22 | 1 | 1 | 1 | 1 | 1 | 56 | 3,106 | | |
| 7/18-7/19 | 229 | 44 | 2 | 2 | 2 | 2 | 1 | 19 | 352 | | |
| 7/20-7/21 | 473 | 72 | 3 | 3 | 3 | 3 | 2 | 49 | 1,136 | | |
| 7/24 | 842 | 209 | 4 | 4 | 4 | 4 | 3 | 45 | 624 | | |
| 7/25 | 272 | 36 | 1 | 1 | 1 | 1 | 1 | 28 | 755 | | |
| 7/27 | 475 | 163 | 14 | 14 | 12 | 12 | 9 | 97 | 959 | | |
| 7/28 | 482 | 191 | 33 | 33 | 30 | 30 | 29 | 271 | 2,323 | | |
| 7/29 | 482 | 81 | 8 | 8 | 8 | 8 | 7 | 154 | 3,263 | | |
| 7/30-7/31 | 1,108 | 390 | 53 | 53 | 51 | 51 | 46 | 484 | 4,806 | | |
| 8/01 | 227 | 86 | 15 | 15 | 14 | 14 | 12 | 117 | 1,040 | | |
| 8/04 | 561 | 407 | 78 | 78 | 76 | 76 | 76 | 388 | 1,720 | | |
| 8/05 | 727 | 146 | 32 | 32 | 32 | 32 | 32 | 590 | 10,583 | | |
| 8/07 | 339 | 252 | 45 | 45 | 44 | 44 | 43 | 214 | 892 | | |
| 8/11 | 628 | 250 | 35 | 35 | 34 | 34 | 34 | 316 | 2,710 | | |
| 8/14 | 1,083 | 415 | 49 | 49 | 49 | 49 | 49 | 474 | 4,292 | | |
| Total | 8,618 | 2,820 | 375 | 375 | 363 | 363 | 345 | 3,303 | 38,563 | 0 | 0 |

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**Appendix A5.-Page 4 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| East Side Setnet 244-30 | | | | | | | | | | | |
| 7/03-7/14 | 992 | 244 | 3 | 3 | 2 | 2 | 0 | 0 | 0 | | |
| 7/17 | 1,666 | 61 | 3 | 2 | 2 | 2 | 1 | 152 | 22,871 | | |
| 7/18-7/19 | 284 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 7/20-7/21 | 708 | 93 | 4 | 4 | 3 | 3 | 2 | 56 | 1,535 | | |
| 7/24 | 625 | 100 | 8 | 8 | 7 | 7 | 6 | 139 | 3,090 | | |
| 7/25 | 497 | 20 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | | |
| 7/27 | 312 | 14 | 4 | 4 | 4 | 4 | 4 | 330 | 26,991 | | |
| 7/28-7/29 | 1,048 | 86 | 8 | 8 | 8 | 8 | 7 | 316 | 14,017 | | |
| 7/30-7/31 | 1,310 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 8/01 | 252 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 8/04-8/05 | 1,843 | 118 | 23 | 23 | 21 | 21 | 21 | 1,215 | 70,261 | | |
| 8/07 | 614 | 126 | 22 | 22 | 22 | 22 | 21 | 379 | 6,579 | | 1 |
| 8/11 | 1,007 | 243 | 56 | 56 | 55 | 55 | 52 | 798 | 11,987 | | |
| 8/14 | 984 | 141 | 25 | 25 | 22 | 22 | 21 | 543 | 13,727 | | |
| Total | 12,142 | 1,273 | 157 | 156 | 147 | 147 | 135 | 3,928 | 171,058 | 0 | 1 |

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**Appendix A5.-Page 5 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| East Side Setnet 244-40 | | | | | | | | | | | |
| 7/03-7/14 | 2,047 | 396 | 2 | 2 | 1 | 1 | 0 | 0 | 0 | | |
| 7/17 | 1,083 | 125 | 3 | 3 | 3 | 3 | 1 | 32 | 998 | | |
| 7/21 | 1,332 | 329 | 11 | 11 | 10 | 10 | 2 | 30 | 420 | | |
| 7/24 | 2,423 | 238 | 5 | 5 | 4 | 4 | 0 | 0 | 0 | | |
| 7/25 | 743 | 195 | 8 | 8 | 8 | 8 | 1 | 14 | 185 | | |
| 7/27 | 602 | 188 | 16 | 15 | 14 | 14 | 13 | 164 | 1,937 | | |
| 7/28-7/29 | 1,889 | 90 | 6 | 6 | 6 | 5 | 3 | 280 | 25,871 | | |
| 7/30-7/31 | 1,796 | 224 | 26 | 26 | 23 | 23 | 16 | 475 | 13,816 | | |
| 8/01 | 548 | 147 | 21 | 21 | 19 | 19 | 11 | 152 | 1,963 | | |
| 8/04-8/05 | 1,859 | 316 | 41 | 41 | 40 | 40 | 37 | 806 | 17,301 | | |
| 8/07 | 834 | 262 | 37 | 37 | 35 | 35 | 34 | 401 | 4,459 | | |
| 8/11 | 1,169 | 211 | 33 | 33 | 32 | 32 | 32 | 657 | 13,175 | | |
| 8/14 | 1,289 | 184 | 38 | 38 | 36 | 36 | 33 | 856 | 21,969 | | 1 |
| Total | 17,614 | 2,905 | 247 | 246 | 231 | 230 | 183 | 3,867 | 102,094 | 0 | 1 |

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**Appendix A5.-Page 6 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| East Side Setnet Unknown b | | | | | | | | | | | |
| 7/14 | | 9 | 0 | 0 | 0 | 0 | 0 | | | 0 | 0 |
| 7/17 | | 162 | 3 | 3 | 3 | 3 | 0 | | | 0 | 0 |
| 7/21 | | 13 | 2 | 2 | 2 | 2 | 2 | | | 0 | 0 |
| 7/24 | | 213 | 8 | 8 | 8 | 8 | 4 | | | 0 | 0 |
| 7/25 | | 43 | 1 | 1 | 1 | 1 | 0 | | | 0 | 0 |
| 7/27 | | 41 | 5 | 5 | 5 | 5 | 5 | | | 0 | 0 |
| 7/28 | | 137 | 14 | 14 | 13 | 13 | 10 | | | 0 | 0 |
| 7/29 | | 15 | 1 | 1 | 1 | 1 | 1 | | | 0 | 0 |
| 7/31 | | 129 | 18 | 18 | 17 | 17 | 10 | | | 0 | 0 |
| 8/01 | | 3 | 0 | 0 | 0 | 0 | 0 | | | 0 | 0 |
| 8/11 | | 185 | 36 | 36 | 36 | 36 | 34 | | | 0 | 0 |
| 8/14 | | 120 | 25 | 25 | 25 | 25 | 23 | | | 0 | 0 |
| Total | | 1,070 | 113 | 113 | 111 | 111 | 89 | 0 | 0 | 0 | 0 |
| East Side Setnet Total | 44,750 | 9,722 | 1,058 | 1,055 | 1,009 | 1,008 | 903 | 13,165 | 343,612 | 0 | 2 |

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**Appendix A5.- Page 7 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chinitna Bay Setnet/Driftnet 245-10 | | | | | | | | | | | |
| 6/30 | 3 | | | | | | | | | | |
| 7/03 | 7 | | | | | | | | | | |
| 7/07 | 22 | | | | | | | | | | |
| 7/10 | 31 | | | | | | | | | | |
| 7/14 | 77 | | | | | | | | | | |
| 7/17 | 91 | | | | | | | | | | |
| 7/21 | 82 | | | | | | | | | | |
| 7/24 | 131 | | | | | | | | | | |
| 7/28 | 57 | | | | | | | | | | |
| 7/31 | 201 | | | | | | | | | | |
| 8/04 | 100 | | | | | | | | | | |
| 8/07 | 100 | | | | | | | | | | |
| 8/11 | 183 | | | | | | | | | | |
| 8/14 | 384 | | | | | | | | | | |
| 8/18 | 2,323 | | | | | | | | | | |
| 8/21 | 1,677 | 128 | 2 | 2 | 0 | 0 | 0 | | | 0 | 0 |
| 8/25 | 2,538 | | | | | | | | | | |
| 8/28 | 1,656 | 248 | 0 | 0 | 0 | 0 | 0 | | | 0 | 0 |
| 9/01 | 722 | | | | | | | | | | |
| 9/04 | 181 | 89 | 0 | 0 | 0 | 0 | 0 | | | 0 | 0 |
| 9/08 | 45 | | | | | | | | | | |
| Total[c] | 10,611 | 465 | 2 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

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## Appendix A5.-Page 8 of 14.

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | V($n_1$) Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Kalgin Island Setnet 246-10/20 | | | | | | | | | | | |
| 6/26 | 1 | | | | | | | | | | |
| 6/30 | 63 | | | | | | | | | | |
| 7/03 | 251 | | | | | | | | | | |
| 7/07 | 1,332 | | | | | | | | | | |
| 7/10 | 558 | | | | | | | | | | |
| 7/14 | 2,345 | 2,235 | 19 | 19 | 12 | 12 | 0 | 0 | | 0 | 0 |
| 7/17 | 2,612 | | | | | | | | | | |
| 7/21 | 9,523 | | | | | | | | | | |
| 7/24 | 3,588 | | | | | | | | | | |
| 7/28 | 3,135 | | | | | | | | | | |
| 7/29 | 213 | | | | | | | | | | |
| 7/31 | 1,923 | | | | | | | | | | |
| 8/02 | 588 | 583 | 23 | 23 | 21 | 21 | 5 | 19 | 316 | 0 | 0 |
| 8/04 | 2,157 | | | | | | | | | | |
| 8/07 | 938 | | | | | | | | | | |
| 8/09 | 790 | 770 | 21 | 21 | 20 | 20 | 3 | 11 | 288 | 0 | 0 |
| 8/11 | 673 | | | | | | | | | | |
| 8/14 | 797 | | | | | | | | | | |
| 8/16 | 561 | 535 | 25 | 25 | 23 | 23 | 5 | 19 | 343 | 0 | 0 |
| 8/18 | 775 | | | | | | | | | | |
| 8/21 | 1,066 | | | | | | | | | | |
| 8/23 | 727 | 420 | 28 | 28 | 28 | 28 | 2 | 13 | 384 | 0 | 0 |
| 8/25 | 87 | | | | | | | | | | |
| 8/28 | 360 | 124 | 4 | 4 | 4 | 4 | 1 | 11 | 55 | 0 | 0 |
| 8/30 | 68 | | | | | | | | | | |
| 9/01 | 212 | 221 | 8 | 8 | 7 | 7 | 3 | 11 | 110 | 0 | 0 |
| 9/04 | 142 | 60 | 0 | 0 | 0 | 0 | 0 | | | 0 | 0 |
| 9/08 | 32 | | | | | | | | | | |
| 9/11 | 27 | | | | | | | | | | |
| 9/15 | 43 | | | | | | | | | | |
| Total[c] | 35,587 | 4,948 | 128 | 128 | 115 | 115 | 19 | 84 | 1,495 | 0 | 0 |

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**Appendix A5.-Page 9 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| West Side Setnet 245-20/30/40/50/55/60 | | | | | | | | | | | |
| 6/30 | 15 | | | | | | | | | | |
| 7/03 | 102 | | | | | | | | | | |
| 7/07 | 593 | | | | | | | | | | |
| 7/10 | 122 | | | | | | | | | | |
| 7/14 | 941 | | | | | | | | | | |
| 7/17 | 1,181 | | | | | | | | | | |
| 7/21 | 3,426 | | | | | | | | | | |
| 7/24 | 1,869 | | | | | | | | | | |
| 7/28 | 1,950 | | | | | | | | | | |
| 7/31 | 2,252 | 156 | 0 | 0 | 0 | 0 | 0 | | | 0 | 0 |
| 8/04 | 2,274 | | | | | | | | | | |
| 8/07 | 1,814 | | | | | | | | | | |
| 8/11 | 1,823 | | | | | | | | | | |
| 8/14 | 2,143 | | | | | | | | | | |
| 8/18 | 3,143 | | | | | | | | | | |
| 8/21 | 3,259 | | | | | | | | | | |
| 8/23 | 1,746 | | | | | | | | | | |
| 8/25 | 922 | | | | | | | | | | |
| 8/28 | 666 | 748 | 5 | 5 | 5 | 5 | 0 | 0 | | 0 | 0 |
| 8/30 | 736 | | | | | | | | | | |
| 9/01 | 1,333 | | | | | | | | | | |
| 9/04 | 270 | 265 | 2 | 2 | 0 | 0 | 0 | | | 0 | 0 |
| Total[c] | 32,580 | 1,169 | 7 | 7 | 5 | 5 | 0 | 0 | 0 | 0 | 0 |

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**Appendix A5.-Page 10 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Mixed (cdd/ess)[d] | | | | | | | | | | | |
| 7/27 | | 15 | 1 | 1 | 1 | 1 | 1 | | | 0 | 0 |
| 7/28 | | 2,141 | 115 | 115 | 110 | 110 | 29 | | | 0 | 0 |
| 7/29 | | 33 | 5 | 5 | 5 | 5 | 4 | | | 0 | 0 |
| 7/31 | | 46 | 9 | 9 | 9 | 9 | 9 | | | 0 | 0 |
| 8/01 | | 193 | 20 | 20 | 19 | 19 | 15 | | | 0 | 0 |
| 8/05 | | 11 | 1 | 1 | 1 | 1 | 1 | | | 0 | 0 |
| 8/14 | | 242 | 39 | 39 | 35 | 35 | 33 | | | 0 | 0 |
| Total | 0 | 2,681 | 190 | 190 | 180 | 180 | 92 | 0 | 0 | 0 | 0 |
| Mixed (csd/wss)[e] | | | | | | | | | | | |
| 9/01 | | 671 | 2 | 2 | 1 | 1 | 0 | | | 0 | 0 |
| 8/25 | | 1,413 | 3 | 3 | 1 | 1 | 0 | | | 0 | 0 |
| Total | 0 | 2,084 | 5 | 5 | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| Mixed (wss/kis)[f] | | | | | | | | | | | |
| 8/21 | | 1,975 | 57 | 57 | 50 | 50 | 2 | | | 0 | 0 |
| Total | 0 | 1,975 | 57 | 57 | 50 | 50 | 2 | 0 | 0 | 0 | 0 |
| **CENTRAL DISTRICT TOTAL** | | | | | | | | | | | |
| | 357,654 | 78,347 | 3,537 | 3,506 | 3,250 | 3,246 | 1,458 | 20,206 | 465,626 | 1 | 2 |

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**Appendix A5.-Page 11 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | **NORTHERN DISTRICT** | | | | | | |
| West Side Setnet 247-10/20/30 | | | | | | | | | | | |
| 6/30-7/14 | 7,723 | 125 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | |
| 7/17 | 10,892 | 2,999 | 17 | 17 | 8 | 8 | 0 | 0 | 0 | | |
| 7/21 | 17,759 | 7,200 | 42 | 41 | 33 | 33 | 0 | 0 | 0 | | |
| 7/28 | 10,244 | 2,300 | 34 | 34 | 28 | 28 | 2 | 33 | 512 | | |
| 7/31 | 4,156 | 2,169 | 26 | 26 | 23 | 23 | 2 | 14 | 87 | | |
| 8/04 | 3,902 | 2,237 | 59 | 59 | 55 | 55 | 4 | 26 | 142 | | |
| 8/07 | 3,489 | 2,278 | 80 | 80 | 75 | 75 | 12 | 68 | 322 | | |
| 8/11 | 1,934 | 996 | 29 | 29 | 27 | 27 | 7 | 50 | 314 | | |
| 8/14 | 1,545 | 1,654 | 47 | 47 | 40 | 40 | 4 | 15 | 40 | | |
| 8/18 | 1,819 | 1,037 | 21 | 21 | 19 | 19 | 2 | 13 | 72 | | |
| 8/21-9/04 | 1,592 | 578 | 58 | 57 | 44 | 43 | 5 | 53 | 513 | | |
| Total | 65,055 | 23,573 | 413 | 411 | 352 | 351 | 38 | 272 | 2,000 | 0 | 0 |
| Pt MacK/Su Flats Setnet 247-41/42 | | | | | | | | | | | |
| 6/30-7/17 | 712 | 231 | 11 | 11 | 11 | 11 | 0 | 0 | 0 | | |
| 7/21 | 726 | 466 | 35 | 35 | 35 | 35 | 0 | 0 | 0 | | |
| 7/28 | 353 | 412 | 24 | 24 | 23 | 23 | 2 | 7 | 20 | | |
| 7/31 | 809 | 551 | 53 | 53 | 51 | 50 | 1 | 6 | 25 | | |
| 8/04 | 445 | 356 | 33 | 33 | 33 | 33 | 0 | 0 | 0 | | |
| 8/07 | 368 | 142 | 24 | 24 | 24 | 24 | 1 | 10 | 83 | | |
| 8/11 | 155 | 124 | 18 | 18 | 17 | 17 | 3 | 14 | 51 | | |
| 8/14 | 166 | 117 | 16 | 16 | 14 | 14 | 0 | 0 | 0 | | |
| 8/18-9/01 | 512 | 28 | 4 | 4 | 4 | 4 | 0 | 0 | 0 | | |
| Total | 4,246 | 2,427 | 218 | 218 | 212 | 211 | 7 | 36 | 178 | 0 | 0 |

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**Appendix A5.-Page 12 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Fire Island Setnet 247-43 | | | | | | | | | | | |
| 7/03-7/17 | 620 | 248 | 24 | 24 | 23 | 23 | 0 | 0 | 0 | | |
| 7/21 | 646 | 528 | 61 | 61 | 54 | 54 | 0 | 0 | 0 | | |
| 7/28 | 474 | 443 | 63 | 63 | 60 | 60 | 0 | 0 | 0 | | |
| 7/31 | 789 | 470 | 69 | 69 | 65 | 65 | 1 | 6 | 32 | | |
| 8/04 | 417 | 112 | 57 | 57 | 53 | 53 | 2 | 28 | 353 | | |
| 8/07 | 476 | 299 | 32 | 32 | 26 | 26 | 0 | 0 | 0 | | |
| 8/11 | 369 | 286 | 44 | 44 | 42 | 42 | 1 | 5 | 18 | | |
| 8/14 | 293 | 165 | 36 | 36 | 33 | 33 | 1 | 7 | 37 | | |
| 8/18 | 312 | 171 | 26 | 26 | 25 | 25 | 1 | 7 | 39 | | |
| 8/21-9/04 | 1,616 | 142 | 32 | 32 | 28 | 28 | 1 | 42 | 1,734 | | |
| Total | 6,012 | 2,864 | 444 | 444 | 409 | 409 | 7 | 94 | 2,214 | 0 | 0 |
| East Side Setnet 247-70/80/90 | | | | | | | | | | | |
| 6/30-7/21 | 2,531 | 486 | 31 | 31 | 31 | 31 | 0 | 0 | 0 | | |
| 7/31 | 959 | 99 | 7 | 7 | 7 | 7 | 0 | 0 | 0 | | |
| 8/04 | 472 | 540 | 13 | 13 | 13 | 13 | 4 | 15 | 40 | | |
| 8/07 | 894 | 984 | 29 | 29 | 27 | 27 | 7 | 26 | 71 | | |
| 8/11 | 788 | 768 | 14 | 14 | 11 | 11 | 4 | 15 | 43 | | |
| 8/14 | 883 | 868 | 34 | 33 | 31 | 31 | 2 | 8 | 22 | | |
| 8/18 | 1,860 | 1,920 | 61 | 61 | 55 | 55 | 2 | 7 | 20 | | |
| 8/21 | 1,368 | 1,494 | 75 | 75 | 70 | 70 | 5 | 19 | 50 | | |
| 8/25 | 1,126 | 1,270 | 41 | 41 | 37 | 37 | 5 | 19 | 50 | | |
| 8/28 | 177 | 176 | 14 | 14 | 11 | 11 | 4 | 15 | 41 | | |
| 9/01 | 533 | 466 | 18 | 18 | 15 | 15 | 2 | 8 | 27 | | |
| 9/04-9/15 | 397 | 310 | 18 | 18 | 17 | 17 | 10 | 45 | 159 | | |
| Total | 11,988 | 9,381 | 355 | 354 | 325 | 325 | 45 | 177 | 524 | 0 | 0 |

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**Appendix A5.-Page 13 of 14.**

| Date | (N) Total Harvest | ($n_2$) Number Examined | ($a_1$) Adclips Observed | ($a_2$) Heads Recovered | ($m_1$) Heads with Tags | ($m_2$) Decodable Tags | ($m_c$) Source= Moose R 1994 | ($n_1$) Harvest Estimate | $V(n_1)$ Variance | Source= Moose R 1993[a] | Source= Skilak Lk 1992[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Knik Arm Setnet 247-50 | | | | | | | | | | | |
| 7/16 | 355 | | | | | | | | | | |
| 7/18 | 361 | | | | | | | | | | |
| 7/23 | 757 | | | | | | | | | | |
| 7/25 | 526 | | | | | | | | | | |
| Total | 1,999 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mixed(ndw/nde)[g] | | | | | | | | | | | |
| 7/17 | | 124 | 3 | 3 | 3 | 3 | 0 | | | 0 | 0 |
| Total | 0 | 124 | 3 | 3 | 3 | 3 | 0 | 0 | 0 | 0 | 0 |
| **NORTHERN DISTRICT TOTAL** | | | | | | | | | | | |
| | 89,300 | 38,369 | 1,433 | 1,430 | 1,301 | 1,299 | 97 | 579 | 4,916 | 0 | 0 |
| **MIXED DISTRICTS** | | | | | | | | | | | |
| Mixed(wss/ndw)[h] | | | | | | | | | | | |
| 8/18 | | 990 | 48 | 48 | 42 | 42 | 6 | | | 0 | 0 |
| Total | 0 | 990 | 48 | 48 | 42 | 42 | 6 | 0 | 0 | 0 | 0 |
| **MIXED DISTRICTS TOTAL** | | | | | | | | | | | |
| | 0 | 990 | 48 | 48 | 42 | 42 | 6 | 0 | 0 | 0 | 0 |
| **ALL DISTRICTS GRAND TOTAL** | | | | | | | | | | | |
| | 446,954 | 117,706 | 5,018 | 4,984 | 4,593 | 4,587 | 1,561 | 20,785 | 470,542 | 1 | 2 |

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[a] Marked fish originally released in 1993 for estimating commercial harvest in 1994 (Carlon and Hasbrouck 1993).

[b] Harvests from multiple statistical areas of the eastside set gillnet fishery were mixed at processing locations prior to examination.

[c] Harvest estimates not expanded to account for unsampled days due to the incidental nature of sampling.

[d] Harvests from the Central District drift gillnet and Central District eastside set gillnet fisheries were mixed at processing locations prior to examination.

[e] Harvests from the Central District westside set gillnet and Central District Chinitna Bay set/drift gillnet fisheries were mixed at processing locations prior to examination.

[f] Harvests from the Central District westside set gillnet and Central District Kalgin Island set gillnet fisheries were mixed at processing locations prior to examination.

[g] Harvests from the Northern District westside set gillnet and Northern District eastside set gillnet fisheries were mixed at processing locations prior to examination.

[h] Harvests from the Central District westside set gillnet and Northern District westside set gillnet fisheries were mixed at processing locations prior to examination.